

WIRELESS COMMUNICATION DEVICE AND WIRELESS COMMUNICATION METHOD

5 BACKGROUND

1. Technical Field

The present disclosure relates to the field of wireless communication, and in particular,
10 to wireless communication devices and wireless communication methods related to reference signal design.

2. Description of the Related Art

15 Latency reduction is a new study item in 3GPP RAN1 and a main assumption is that the transmission time interval (TTI) length can be shortened from 14 orthogonal frequency division multiplexing (OFDM) symbols (1ms) to 7 or less OFDM symbol(s) to reduce the latency. The TTI whose length is 7 or less OFDM symbol(s) is also referred to a shortened TTI (also abbreviated as sTTI) hereafter.

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SUMMARY

One non-limiting and exemplary embodiment provides reference signal design with respect to shortened TTIs for latency reduction.

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In an embodiment of the present disclosure, there is provided a wireless communication device comprising: circuitry operative to map at least a first type of reference signals (RSs) onto orthogonal frequency division multiplexing (OFDM) symbol(s) other than the OFDM symbols onto which shortened transmission time

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intervals (TTIs) are mapped in a subframe, each of the shortened TTIs comprising 1-7 OFDM symbols; and a transmitter operative to transmit a physical channel in one of the shortened TTIs and transmit at least the first type of RSs.

- 5 In an embodiment of the present disclosure, there is provided a wireless communication method comprising: mapping at least a first type of reference signals (RSs) onto orthogonal frequency division multiplexing (OFDM) symbol(s) other than the OFDM symbols onto which shortened transmission time intervals (TTIs) are mapped in a subframe, each of the shortened TTIs comprising 1-7 OFDM symbols; and
10 transmitting a physical channel in one of the shortened TTIs and transmitting at least the first type of RSs.

- In an embodiment of the present disclosure, there is provided a wireless communication device comprising: circuitry operative to map at most one type of
15 reference signals (RSs) from cell-specific reference signals (CRSs) and demodulation reference signals (DMRSs) in each shorten transmission time interval (TTI) in a subframe, each shortened TTI comprising 1-7 orthogonal frequency division multiplexing (OFDM) symbols; and a transmitter operative to transmit a physical channel in a shorten TTI, the RSs within the OFDM symbol(s) of or before the shorten
20 TTI transmitting the physical channel being used to demodulate the physical channel at a receiving side.

- In an embodiment of the present disclosure, there is provided a wireless communication method comprising: mapping at most one type of reference signals
25 (RSs) from cell-specific reference signals (CRSs) and demodulation reference signals (DMRSs) in each shorten transmission time interval (TTI) in a subframe, each shortened TTI comprising 1-7 orthogonal frequency division multiplexing (OFDM) symbols; and transmitting a physical channel in a shorten TTI, the RSs within the OFDM symbol(s) of or before the shorten TTI transmitting the physical channel being
30 used to demodulate the physical channel at a receiving side.

It should be noted that general or specific embodiments may be implemented as a system, a method, an integrated circuit, a computer program, a storage medium, or any selective combination thereof.

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In an aspect of the present disclosure, there is provided a communication apparatus, comprising: circuitry, which, in operation, maps a reference signal (RS) and a physical channel to a first one of a plurality of subgroups; and a transmitter, which is coupled to the circuitry and which, in operation, transmits the mapped RS and the mapped physical channel in the first one
10 of the plurality of subgroups; wherein none of RSs are mapped to a second one of the plurality of subgroups and a third one of the plurality of subgroups, wherein the first one of the plurality of subgroups is assigned between the second one of the plurality of subgroups and the third one of the plurality of subgroups, and wherein a number of subgroups of the plurality of subgroups between adjacent subgroups of the plurality of subgroups, having a first type of RS,
15 differs within a subframe comprising the plurality of subgroups.

In an aspect of the present disclosure, there is provided a communication method, comprising: mapping a reference signal (RS) and a physical channel to a first one of a plurality of subgroups; and transmitting the mapped RS and the mapped physical channel in the first one
20 of the plurality of subgroups; wherein none of RSs are mapped to a second one of the plurality of subgroups and a third one of the plurality of subgroups, wherein the first one of the plurality of subgroups is assigned between the second one of the plurality of subgroups and the third one of the plurality of subgroups, and wherein a number of subgroups of the plurality of subgroups between adjacent subgroups of the plurality of subgroups, having a first type of RS,
25 differs within a subframe comprising the plurality of subgroups.

Additional benefits and advantages of the disclosed embodiments will become apparent from the specification and drawings. The benefits and/or advantages may be individually obtained by the various embodiments and features of the specification and
30 drawings, which need not all be provided in order to obtain one or more of such benefits and/or advantages.

BRIEF DESCRIPTION OF DRAWINGS

The foregoing and other features of the present disclosure will become more fully
5 apparent from the following description and appended claims, taken in conjunction with
the accompanying drawings. Understanding that these drawings depict only several
embodiments in accordance with the disclosure and are, therefore, not to be
considered limiting of its scope, the disclosure will be described with additional
specificity and detail through use of the accompanying drawings, in which:

10 Fig. 1 schematically illustrates some examples of TTI length reduction;

Fig. 2 schematically illustrates a block diagram of a wireless communication device
according to an embodiment of the present disclosure;

Fig. 3 illustrates a flowchart of a wireless communication method according to an
embodiment of the present disclosure;

15 Fig. 4 illustrates a flowchart of a wireless communication method according to an
embodiment of the present disclosure;

Fig. 5 schematically illustrates an exemplary downlink reference signal design
according to an embodiment of the present disclosure;

CLAIMS

1. A communication apparatus, comprising:
circuitry, which, in operation, maps a reference signal (RS) and a physical channel to a first one
of a plurality of subgroups; and
5 a transmitter, which is coupled to the circuitry and which, in operation, transmits the mapped
RS and the mapped physical channel in the first one of the plurality of subgroups;
wherein none of RSs are mapped to a second one of the plurality of subgroups and a third one
of the plurality of subgroups, wherein the first one of the plurality of subgroups is assigned
between the second one of the plurality of subgroups and the third one of the plurality of
10 subgroups, and wherein a number of subgroups of the plurality of subgroups between adjacent
subgroups of the plurality of subgroups, having a first type of RS, differs within a subframe
comprising the plurality of subgroups.
2. The communication apparatus according to claim 1, wherein the RS mapped on a symbol is
15 used for some or all of the plurality of subgroups.
3. The communication apparatus according to claim 1, wherein a position of the RS is indicated
by downlink control information (DCI).
- 20 4. The communication apparatus according to claim 1, wherein RS port numbers are indicated
by Radio Resource Control (RRC) signaling.
5. The communication apparatus according to claim 1, wherein the physical channel is mapped
after the RS.
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6. The communication apparatus according to claim 1, wherein the first type of RS is a
demodulation reference signal (DMRS).
7. A communication method, comprising:
30 mapping a reference signal (RS) and a physical channel to a first one of a plurality of
subgroups; and
transmitting the mapped RS and the mapped physical channel in the first one of the plurality of
subgroups;

wherein none of RSs are mapped to a second one of the plurality of subgroups and a third one of the plurality of subgroups, wherein the first one of the plurality of subgroups is assigned between the second one of the plurality of subgroups and the third one of the plurality of subgroups, and wherein a number of subgroups of the plurality of subgroups between adjacent subgroups of the plurality of subgroups, having a first type of RS, differs within a subframe comprising the plurality of subgroups.

8. The communication method according to claim 7, wherein the RS mapped on a symbol is used for some or all of the plurality of subgroups.

9. The communication method according to claim 7, wherein a position of the RS is indicated by downlink control information (DCI).

10. The communication method according to claim 7, wherein RS port numbers are indicated by Radio Resource Control (RRC) signaling.

11. The communication method according to claim 7, wherein the physical channel is mapped after the RS.

12. The communication method according to claim 7, wherein the first type of RS is a demodulation reference signal (DMRS).