

By using a plurality of subframe channel estimation and symbol level combining, the PUSCH transmission quality may be improved compared to simple repetition that performs channel estimation and the demodulation/decoding of SC-FDMA data symbols at the subframe level (for example, see NPL 5).

Citation List

Non Patent Literature

[0013]

NPL 1: 3GPP TS 36.211 V13.0.0, "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation (Release 13)," December 2015.

NPL 2: 3GPP TS 36.212 V13.0.0, "Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding (Release 13)," December 2015.

NPL 3: 3GPP TS 36.213 V13.0.0, "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures (Release 13)," December 2015.

NPL 4: RP-151621, Qualcomm, "New Work Item: NarrowBand IOT (NB-IOT)"

NPL 5: R1-150312, Panasonic, "Discussion and performance evaluation on PUSCH coverage enhancement"

NPL 6: R1-151587, Samsung, "Considerations of legacy SRS impact on uplink transmission from low-cost UE," April 2015

NPL 7: R1-152703, LG Electronics, "Discussion on PUSCH transmission for MTC," May 2015

Summary

[0014]

In a cell that supports NB-IoT terminals, it is necessary to accommodate the coexistence of NB-IoT terminals and existing LTE terminals, and it is desirable to improve the transmission quality for NB-IoT terminals while minimizing the impact on the existing LTE system.

[0014a]

In a first aspect, the present disclosure provides a communication apparatus comprising: a receiver which receives allocation information by which to allocate a resource including a plurality of symbols and a plurality of subcarriers and demodulation reference signal (DMRS) information relating to a number of

consecutive symbols to which a DMRS signal is to be mapped, and a transmitter which transmits a signal including the DMRS which is provided in a part of the resource based on the received DMRS information.

[0014b]

In a second aspect, the present disclosure provides a communication method comprising: receiving allocation information by which to allocate a resource including a plurality of symbols and a plurality of subcarriers and demodulation reference signal (DMRS) information relating to a number of consecutive symbols to which a DMRS signal is to be mapped, and transmitting a signal including the DMRS which is provided in a part of the resource based on the received DMRS information.

[0014c]

In a third aspect, the present disclosure provides an integrated circuit controlling: a reception process to receive allocation information by which to allocate a resource including a plurality of symbols and a plurality of subcarriers and demodulation reference signal (DMRS) information relating to a number of consecutive symbols to which a DMRS signal is to be mapped, and a transmission process to transmit a signal including the DMRS which is provided in a part of the resource based on the received DMRS information.

[0015]

An embodiment of the present disclosure provides a terminal and a transmission method capable of improving the transmission quality for NB-IoT terminals while minimizing the impact on an existing LTE system.

[0016]

A terminal according to an embodiment of the present disclosure adopts a configuration including: a repetition unit that performs a repetition for mapping a data signal and a demodulation reference signal (DMRS) repeatedly at a symbol level over a plurality of subframes; a signal allocation unit that maps, in the a plurality of subframes, the repeated DMRS to symbols other than symbols corresponding to an SRS resource candidate, which is a candidate for a resource to which a sounding reference signal (SRS) used to measure an uplink received signal quality is to be mapped; and a transmission unit that transmits an uplink signal including the DMRS and the data signal in the a plurality of subframes.

[0017]

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.

[0018]

According to an embodiment of the present disclosure, it is possible to improve the transmission quality for NB-IoT terminals while minimizing the impact on an existing LTE system.

[0019]

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

Brief Description of Drawings

[0020]

[Fig. 1] Fig. 1 is a diagram illustrating an example of a PUSCH subframe configuration.

[Fig. 2] Fig. 2 is a diagram illustrating an example of an srs-SubframeConfig definition.

[Fig. 3] Fig. 3 is a diagram illustrating an exemplary setting of SRS transmission candidate subframes and SRS resources.

[Fig. 4] Fig. 4 is a diagram illustrating exemplary operations of a plurality of subframe channel estimation and symbol level combining.

[Fig. 5] Fig. 5 is a diagram illustrating exemplary operations of repetition at

1. A communication apparatus comprising:
 - a receiver which receives allocation information by which to allocate a resource including a plurality of symbols and a plurality of subcarriers and demodulation reference signal (DMRS) information relating to a number of consecutive symbols to which a DMRS signal is to be mapped, and
 - a transmitter which transmits a signal including the DMRS which is provided in a part of the resource based on the received DMRS information.
2. The communication apparatus according to claim 1, wherein
 - the DMRS is periodically provided in a plurality of time periods within the resource, and
 - the DMRS is provided in one or more symbol(s) for each of the a plurality of time periods based on the DMRS information.
3. The communication apparatus according to claim 1, wherein
 - the DMRS is provided in symbols other than symbol candidates in which a sounding reference signal (SRS) is to be provided that are reported in a higher layer.
4. The communication apparatus according to claim 1, wherein
 - the DMRS is provided in one or more symbol(s) corresponding to the DMRS information from at least a first symbol of the resource.
5. The communication apparatus according to claim 1, wherein
 - the resource includes a plurality of time units and each of the time units includes a plurality of symbols, and
 - the DMRS is provided from a beginning of the time units.

6. The communication apparatus according to claim 1, wherein the DMRS information is reported in a higher layer.
7. The communication apparatus according to claim 1, wherein the allocation information indicates a number of subcarriers selected from among a plurality of subcarrier number candidates, and each of the a plurality of subcarrier number candidates corresponds to a number of symbols different from each other.
8. The communication apparatus according to claim 1, wherein the a plurality of subcarriers includes 12 subcarriers or less than 12 subcarriers.
9. The communication apparatus according to claim 1, wherein data is provided in the resource, the data being generated without assuming symbol candidates in which a sounding reference signal (SRS) is to be provided and punctured before transmission.
10. A communication method comprising:
 - receiving allocation information by which to allocate a resource including a plurality of symbols and a plurality of subcarriers and demodulation reference signal (DMRS) information relating to a number of consecutive symbols to which a DMRS signal is to be mapped, and
 - transmitting a signal including the DMRS which is provided in a part of the resource based on the received DMRS information.
11. The communication method according to claim 10, wherein the DMRS is periodically provided in a plurality of time periods within the

resource, and

the DMRS is provided in one or more symbol(s) for each of the a plurality of time periods based on the DMRS information.

12. The communication method according to claim 10, wherein

the DMRS is provided in symbols other than symbol candidates in which a sounding reference signal (SRS) is to be provided that are reported in a higher layer.

13. The communication method according to claim 10, wherein

the DMRS is provided in one or more symbol(s) corresponding to the DMRS information from at least a first symbol of the resource.

14. The communication method according to claim 10, wherein

the resource includes a plurality of time units and each of the time units includes a plurality of symbols, and

the DMRS is provided from a beginning of the time units.

15. The communication method according to claim 10, wherein

the DMRS information is reported in a higher layer.

16. The communication method according to claim 10, wherein

the allocation information indicates a number of subcarriers selected from among a plurality of subcarrier number candidates, and each of the a plurality of subcarrier number candidates corresponds to a number of symbols different from each other.

17. The communication method according to claim 10, wherein

the a plurality of subcarriers includes 12 subcarriers or less than 12 subcarriers.

18. The communication method according to claim 10, wherein
data is provided in the resource, the data being generated without assuming symbol candidates in which a sounding reference signal (SRS) is to be provided and punctured before transmission.

19. An integrated circuit controlling:
a reception process to receive allocation information by which to allocate a resource including a plurality of symbols and a plurality of subcarriers and demodulation reference signal (DMRS) information relating to a number of consecutive symbols to which a DMRS signal is to be mapped, and
a transmission process to transmit a signal including the DMRS which is provided in a part of the resource based on the received DMRS information.