

CLAIMS

1. A method comprising:

generating a plurality of information bits containing downlink control information for a user equipment (UE) in a mobile communication network, wherein the plurality of information bits is attached with a plurality of cyclic redundancy check (CRC) bits;

performing channel encoding on the plurality of information bits with the plurality of CRC bits and thereby outputting a plurality of encoded bits;

applying cyclic-shifting before or after the channel encoding using a UE-specific ID; and

transmitting the downlink control information over allocated radio resources of a physical downlink control channel (PDCCH) to the UE.

2. The method of Claim 1, wherein the plurality of CRC bits is masked by a UE ID.

3. The method of Claim 1, wherein the cyclic-shifting is applied on the plurality of encoded bits after the channel encoding.

4. The method of Claim 1, further comprising:

performing modulation mapping on the plurality of encoded bits and outputting a plurality of modulation symbols.

5. The method of Claim 4, wherein the cyclic-shifting is a type of channel interleaving applied on the plurality of modulation symbols after the modulation mapping.

6. The method of Claim 5, wherein the channel interleaving subsumes the modulation symbols to different physical locations of the allocated radio resources.

7. The method of Claim 1, wherein the cyclic-shifting is applied before the channel encoding, wherein the plurality of CRC bits is masked by a UE ID, and wherein the cyclic-shifting is based on the UE-specific ID.

8. The method of Claim 1, wherein the cyclic-shifting is applied before the channel encoding, wherein the plurality of CRC bits is masked by a first portion of a UE ID, and wherein the cyclic-shifting is based on a second portion of the UE ID.

9. The method of Claim 1, wherein the plurality of encoded bits is also scrambled and interleaved before the PDCCH transmission.

10. The method of Claim 1, wherein the UE-specific ID is a configurable ID provided by the network to the UE.

11. A transmitting device, comprising:

a control circuit that generates a plurality of information bits containing downlink

control information for a user equipment (UE) in a mobile communication network, wherein the plurality of

information bits is attached with a plurality of cyclic redundancy check (CRC) bits;

an encoder that performs channel encoding on the plurality of information bits with the plurality of CRC bits and thereby outputting a plurality of encoded bits;

an interleaver that applies cyclic-shifting before or after the channel encoding using a
5 UE-specific ID; and

a radio frequency (RF) transmitter that transmits the downlink control information over allocated radio resources of a physical downlink control channel (PDCCH) to the UE.

12. The device of Claim 11, wherein the plurality of CRC bits is masked by a UE ID.

13. The device of Claim 11, wherein the cyclic-shifting is applied on the plurality of
10 encoded bits after the channel encoding.

14. The device of Claim 11, further comprising:

a modulator that performs modulation mapping on the plurality of encoded bits and outputting a plurality of modulation symbols.

15. The device of Claim 14, wherein the cyclic-shifting is a type of channel interleaving
15 applied on the plurality of modulation symbols after the modulation mapping.

16. The device of Claim 15, wherein the channel interleaving subsumes the modulation symbols to different physical locations of the allocated radio resources.

17. The device of Claim 11, wherein the cyclic-shifting is applied before the channel encoding, wherein the plurality of CRC bits is masked by a UE ID, and wherein the cyclic-
20 shifting is based on the UE-specific ID.

18. The device of Claim 11, wherein the cyclic-shifting is applied before the channel encoding, wherein the plurality of CRC bits is masked by a first portion of a UE ID, and wherein the cyclic-shifting is based on a second portion of the UE ID.

19. The device of Claim 11, wherein the plurality of encoded bits is also scrambled and
25 interleaved before the PDCCH transmission.

20. The device of Claim 11, wherein the UE-specific ID is a configurable ID provided by the network to the UE.