

CLAIMS

1. A method ~~for~~of wireless communication; at a user equipment (UE), the method comprising:
 - determining, ~~in a device~~by the UE, a signal quality for communicating with a node;
 - determining, ~~in~~by the deviceUE, a coverage level based on the signal quality, wherein the coverage level indicates resources to be used for communicating with the node;
 - determining, ~~in~~by the deviceUE, a maximum repetition level and a repetition value, based on the coverage level, for communicating with the node;
 - generating, ~~in~~by the deviceUE, a multibit repetition range identifier that indicates the repetition value based on the maximum repetition level; ~~and~~, wherein the multibit repetition range identifier comprises one of a plurality of bit combinations, wherein the plurality of bit combinations comprises at least a first bit combination mapped to a first positive value, a second bit combination mapped to a second positive value, and a third bit combination mapped to a third positive value, wherein the first positive value is half of the maximum repetition level, the second positive value is twice the maximum repetition level, and the third positive value is between half of the maximum repetition level and twice the maximum repetition level; and
 - transmitting, by the UE, the multibit repetition range identifier.
2. The method of claim 1, wherein the repetition value is based on a number of repetitions needed to decode a Narrowband Physical Downlink Control Channel (NPDCCH) signal with a predetermined minimum block error rate (BLER).
3. The method of claim 2, wherein the predetermined BLER is less than, or equal to, 1%.
4. The method of claim 1, wherein ~~the determining~~, by the UE, the signal quality comprises measuring, by the UE, a downlink narrowband reference signal received power (NRSRP).
5. The method of claim 4, wherein ~~the determining~~, by the UE, the coverage level comprises:

—comparing, by the UE, the measured NRSRP to one or more thresholds, wherein each threshold ~~corresponding of the one or more thresholds corresponds~~ to a different coverage level.

6. The method of claim 1, wherein ~~the~~ determining the repetition value comprises generating a virtual Narrowband Physical Downlink Control Channel (NPDCCH) signal that is based on one or more predetermined parameters.

7. The method of claim 6, wherein the one or more predetermined parameters comprise at least one of:

- a search space in which a random access response is received,
- a Narrowband Physical Downlink Control Channel (NPDCCH) in which downlink control information (DCI) scheduling for a random access request is received,
- a Narrowband Physical Downlink Shared Channel (NPDSCH) carrying a random access response message,
- a subframe for a first narrowband physical uplink shared channel (NPUSCH) subframe carrying a connection request message,
- a start of a random access request (RAR) window, ~~and/or~~
- after a transmission of a connection request message.

8. The method of claim 1, wherein ~~the~~ determining the maximum repetition level comprises receiving the maximum repetition level from the node.

9. The method of claim 1, further comprising detecting and decoding a Narrowband Physical Downlink Control Channel (NPDCCH) signal based on the repetition value.

10. The method of claim 1, ~~wherein the multibit repetition range identifier comprises one of a plurality of bit combinations, and~~ wherein the repetition value indicates a number of repetitions for decoding a Narrowband Physical Downlink Control Channel (NPDCCH) signal.

11. ~~The method of claim 10, wherein the plurality of bit combinations comprises at least a first bit combination mapped to a first value, a second bit combination mapped to a second value, and a third bit combination mapped to a third value, wherein the first value is half of the maximum repetition level, the second value is twice the maximum repetition level, and the third value is between half of the maximum repetition level and twice the maximum repetition level.~~

12. —An apparatus for communication, comprising:

one or more antennas,

a processing apparatus, operatively coupled to the one or more antennas, the processing apparatus being configured to:

determine a signal quality for communicating with a node;

determine a coverage level based on the signal quality, wherein the coverage level indicates resources to be used for communicating with the node;

determine a maximum repetition level and a repetition value, based on the coverage level, for communicating with the node;

~~the coverage level, for communicating with the node;~~

generate a multibit repetition range identifier that indicates the repetition

value based on the maximum repetition level, wherein the multibit repetition range identifier comprises one of a plurality of bit combinations, wherein the plurality of bit combinations comprises at least a first bit combination mapped to a first positive value, a second bit combination mapped to a second positive value, and a third bit combination mapped to a third positive value, wherein the first positive value is half of the maximum repetition level, the second positive value is twice the maximum repetition level, and the third positive value is between half of the maximum repetition level and twice the maximum repetition level; and

transmit the multibit repetition range identifier.

~~13~~12. The apparatus of claim ~~12~~11, wherein the repetition value is based on a number of repetitions needed to decode a Narrowband Physical Downlink Control Channel (NPDCCH) signal with a predetermined minimum block error rate (BLER).

~~14. —The apparatus of claim 13.~~ The apparatus of claim 12, wherein the predetermined BLER is less than, or equal to, 1%.

~~45~~14. The apparatus of claim ~~40~~11, wherein the processing apparatus configured to determine the signal quality is further configured to measure a downlink narrowband reference signal received power (NRSRP).

~~46~~15. The apparatus of claim ~~45~~14, wherein the processing apparatus configured to determine the coverage level is further configured to compare the measured NRSRP to one or more thresholds, each threshold corresponding to a different coverage level.

~~47~~16. The apparatus of claim ~~42~~11, wherein the processing apparatus configured to determine the maximum repetition level and the repetition value is further configured to generate a virtual Narrowband Physical Downlink Control Channel (NPDCCH) signal that is based on one or more predetermined parameters.

~~48~~17. The apparatus of claim ~~47~~16, wherein the one or more predetermined parameters comprise at least one of:

- a search space in which a random access response is received,
- a Narrowband Physical Downlink Control Channel (NPDCCH) in which downlink control information (DCI) scheduling for a random access request is received,
- a Narrowband Physical Downlink Shared Channel (NPDSCH) carrying a random access response message,
- a subframe for a first narrowband physical uplink shared channel (NPUSCH) subframe carrying a connection request message,
- a start of a random access request (RAR) window, ~~and/or~~
- after a transmission of a connection request message.

~~49~~18. The apparatus of claim ~~42~~11, wherein the processing apparatus configured to determine the maximum repetition level and the repetition value is further configured to receive the maximum repetition level from the node.

~~20~~19. The apparatus of claim ~~12~~11, wherein the processing apparatus is further configured to detect and decode a Narrowband Physical Downlink Control Channel (NPDCCH) signal based on the repetition value.

~~21~~20. The apparatus of claim ~~12~~, wherein the multibit repetition range identifier comprises one of a plurality of bit combinations, and ~~11~~11, wherein the repetition value indicates a number of repetitions for decoding a Narrowband Physical Downlink Control Channel (NPDCCH) signal.

~~22~~. The apparatus of claim ~~21~~, wherein the plurality of bit combinations comprises at least a first bit combination mapped to a first value, a second bit combination mapped to a second value, and a third bit combination mapped to a third value, wherein the first value is half of the maximum repetition level, the second value is twice the maximum repetition level, and the third value is between half of the maximum repetition level and twice the maximum repetition level.

~~23~~21. An apparatus comprising:

means for determining a signal quality for communicating with a node;

means for determining a coverage level based on the signal quality, wherein the coverage level indicates resources to be used for communicating with the node;

means for determining a maximum repetition level and a repetition value, based on the coverage level, for communicating with the node;

means for generating a multibit repetition range identifier that indicates the repetition value based on the maximum repetition level; and, wherein the multibit repetition range identifier comprises one of a plurality of bit combinations, wherein the plurality of bit combinations comprises at least a first bit combination mapped to a first positive value, a second bit combination mapped to a second positive value, and a third bit combination mapped to a third positive value, wherein the first positive value is half of the maximum repetition level, the second positive value is twice the maximum repetition level, and the third positive value is between half of the maximum repetition level and twice the maximum repetition level; and

means for transmitting the multibit repetition range identifier.

~~24~~22. The apparatus of claim ~~23~~21, wherein the maximum repetition level is based on a number of repetitions needed to decode a Narrowband Physical Downlink Control Channel (NPDCCH) signal with a predetermined minimum block error rate (BLER).

~~25~~23. The apparatus of claim ~~24~~22, wherein the predetermined BLER is less than, or equal to, 1%.

~~26~~24. The apparatus of claim ~~23~~21, further comprising means for detecting and decoding a Narrowband Physical Downlink Control Channel (NPDCCH) signal based on the repetition value.

~~27~~25. The apparatus of claim ~~23~~, ~~wherein the multibit repetition range identifier comprises one of a plurality of bit combinations, and~~21, wherein the repetition value indicates a number of repetitions for decoding a Narrowband Physical Downlink Control Channel (NPDCCH) signal.

~~28. The apparatus of claim 27, wherein the plurality of bit combinations comprises at least a first bit combination mapped to a first value, a second bit combination mapped to a second value, and a third bit combination mapped to a third value, wherein the first value is half of the maximum repetition level, the second value is twice the maximum repetition level, and the third value is between half of the maximum repetition level and twice the maximum repetition level.~~

~~29~~26. A non-transitory computer-readable medium storing computer-executable code, comprising code for causing a computer to:

determine a signal quality for communicating with a node;

determine a coverage level based on the signal quality, wherein the coverage level indicates resources to be used for communicating with the node;

determine a maximum repetition level and a repetition value, based on the coverage level, for communicating with the node;

generate a multibit repetition range identifier that indicates the repetition value based on the maximum repetition level; ~~and, wherein the multibit repetition range identifier comprises one of a plurality of bit combinations, wherein the plurality of bit combinations comprises at least a first bit combination mapped to a first positive value, a second bit combination mapped to a second positive value, and a third bit combination mapped to a third positive value, wherein the first positive value is half of the maximum repetition level, the second positive value is twice the maximum repetition level, and the third positive value is between half of the maximum repetition level and twice the maximum repetition level; and~~

transmit the multibit repetition range identifier.

~~30~~27. The non-transitory computer-readable medium of claim ~~29~~26, wherein the code further causes the computer to detect and decode a Narrowband Physical Downlink Control Channel (NPDCCH) signal based on the repetition value.

28. The method of claim 1, wherein the multibit repetition range identifier is generated based on a scaling value and the maximum repetition level.

29. The apparatus of claim 11, wherein the multibit repetition range identifier is generated based on a scaling value and the maximum repetition level.

30. The apparatus of claim 21, wherein the multibit repetition range identifier is generated based on a scaling value and the maximum repetition level.