

WHAT IS CLAIMED IS:

1. A method of wireless communication performed by a user equipment (UE), comprising:
receiving, from a base station, a random access channel (RACH) occasion (RO) configuration that includes information related to ordered preamble resources;
generating a preamble resource index according to a plurality of parameters that are selected based at least in part on the information in the RO configuration that relates to the ordered preamble resources; and
generating an uplink RACH message that includes a preamble based at least in part on the preamble resource index and a payload associated with a physical uplink shared channel (PUSCH) resource unit (PRU) mapped to the preamble resource index.
2. The method of claim 1, wherein the information in the RO configuration relates to one or more ROs dedicated to a two-step RACH procedure or one or more ROs shared between the two-step RACH procedure and a four-step RACH procedure.
3. The method of claim 1, wherein the information related to the ordered preamble resources includes one or more indexes that are repeated in different synchronization signal block (SSB)-RO association periods.
4. The method of claim 1, wherein the information related to the ordered preamble resources indicates that preamble resources are ordered sequentially based at least in part on preamble sequence indexes within an RO, frequency resource indexes for a set of ROs associated with a frequency division multiplexing (FDM) configuration, time resource indexes for a set of ROs associated with a time division multiplexing (TDM) configuration within a physical RACH (PRACH) slot, and a set of PRACH slot indexes.
5. The method of claim 4, wherein the plurality of parameters used to generate the preamble resource index include a first parameter selected from the preamble sequence indexes within the RO, a second parameter selected from the frequency resource indexes for the set of ROs associated with the FDM configuration, a third parameter selected from the time resource indexes for the set of ROs associated with the TDM configuration, and a fourth parameter selected from the set of PRACH slot indexes.
6. The method of claim 1, wherein the preamble resource index is generated based at least in part on a function that applies different weights to respective parameters of the plurality of parameters.

7. The method of claim 1, wherein the PRU configuration associated with the payload is one of multiple PRU configurations associated with time and frequency resources that are configured for the uplink RACH message.
8. The method of claim 7, wherein the multiple PRU configurations are indexed based at least in part on indexes associated with the ordered preamble resources.
9. The method of claim 7, wherein generating the uplink RACH message includes:
 - ordering the multiple PRU configurations according to one or more criteria; and
 - selecting the PRU configuration associated with the payload from the multiple PRU configurations based at least in part on the ordering.
10. The method of claim 9, wherein the one or more criteria used to order the multiple PRU configurations include one or more of an ascending modulation coding scheme or an ascending transport block size, based at least in part on the multiple PRU configurations overlapping in one or more of the time or frequency resources.
11. The method of claim 9, wherein the one or more criteria used to order the multiple PRU configurations include one or more of ascending frequency occasions or ascending time occasions, based at least in part on the multiple PRU configurations not overlapping in the time or frequency resources.
12. The method of claim 1, wherein generating the uplink RACH message includes:
 - generating a scrambling identifier for the payload according to a set of parameters that is based at least in part on an index associated with the preamble; and
 - scrambling the payload using the scrambling identifier.
13. The method of claim 12, wherein the set of parameters used to generate the scrambling identifier is further based at least in part on a random access radio network temporary identifier and a data scrambling identifier configured by the base station.
14. The method of claim 12, wherein the scrambling identifier is generated based at least in part on a function that applies different weights to respective parameters of the set of parameters.

15. The method of claim 12, wherein generating the uplink RACH message further includes generating a demodulation reference signal (DMRS) sequence associated with the uplink RACH message, wherein the DMRS sequence is scrambled based at least in part on the scrambling identifier for the payload and one or more time-dependent parameters associated with a PUSCH waveform used to transmit the payload.

16. The method of claim 1, wherein the uplink RACH message is associated with a two-step RACH procedure.

17. The method of claim 1, further comprising:
transmitting, to the base station, the preamble associated with the uplink RACH message and the payload associated with the uplink RACH message, wherein the preamble and the payload are transmitted in separate symbols based at least in part on a time division multiplexing configuration, and wherein the payload carries at least one of a unique identifier associated with the UE, a medium access control layer control element, or user plane or control plane data.

18. The method of claim 17, further comprising:
receiving, from the base station, a downlink response message to the uplink RACH message, wherein the downlink response message includes a physical downlink control channel (PDCCH) and a physical downlink shared channel (PDSCH), and wherein the PDCCH includes a cyclic redundancy code (CRC) masked by a radio network temporary identifier (RNTI) and the PDSCH carries at least a portion of the identifier associated with the UE.

19. The method of claim 18, wherein the RNTI masking the CRC of the PDCCH is a UE-specific identifier individually targeting the UE, and wherein the RNTI is based at least in part on one or more of a data scrambling identifier for a physical uplink shared channel, a demodulation reference signal scrambling identifier associated with the uplink RACH message, the preamble resource index, or the identifier associated with the UE that is carried in the payload of the uplink RACH message.

20. The method of claim 18, wherein the RNTI masking the CRC of the PDCCH is a group identifier targeting a group of UEs sharing a particular RO, and wherein the RNTI is based at least in part on one or more of a resource index associated with the particular RO shared by the group of UEs, a common time and frequency resource index associated with one or more PRUs shared by the group of UEs, a common demodulation reference signal resource index shared by

the group of UEs, or a time and frequency resource index associated with the downlink response message.

21. A user equipment (UE) for wireless communication, comprising:
 - a memory; and
 - one or more processors operatively coupled to the memory, the memory and the one or more processors configured to:
 - receive, from a base station, a random access channel (RACH) occasion (RO) configuration that includes information related to ordered preamble resources;
 - generate a preamble resource index according to a plurality of parameters that are selected based at least in part on the information in the RO configuration that relates to the ordered preamble resources; and
 - generate an uplink RACH message that includes a preamble based at least in part on the preamble resource index and a payload associated with a physical uplink shared channel (PUSCH) resource unit (PRU) mapped to the preamble resource index.
22. The UE of claim 21, wherein the information in the RO configuration relates to one or more ROs dedicated to a two-step RACH procedure or one or more ROs shared between the two-step RACH procedure and a four-step RACH procedure.
23. The UE of claim 21, wherein the information related to the ordered preamble resources includes one or more indexes that are repeated in different synchronization signal block (SSB)-RO association periods.
24. The UE of claim 21, wherein the information related to the ordered preamble resources indicates that preamble resources are ordered sequentially based at least in part on preamble sequence indexes within an RO, frequency resource indexes for a set of ROs associated with a frequency division multiplexing (FDM) configuration, time resource indexes for a set of ROs associated with a time division multiplexing (TDM) configuration within a physical RACH (PRACH) slot, and a set of PRACH slot indexes.
25. The UE of claim 24, wherein the plurality of parameters used to generate the preamble resource index include a first parameter selected from the preamble sequence indexes within the RO, a second parameter selected from the frequency resource indexes for the set of ROs associated with the FDM configuration, a third parameter selected from the time resource indexes for the set of ROs associated with the TDM configuration, and a fourth parameter selected from the set of PRACH slot indexes.

26. The UE of claim 21, wherein the preamble resource index is generated based at least in part on a function that applies different weights to respective parameters of the plurality of parameters.
27. The UE of claim 21, wherein the PRU configuration associated with the payload is one of multiple PRU configurations associated with time and frequency resources that are configured for the uplink RACH message.
28. The UE of claim 27, wherein the multiple PRU configurations are indexed based at least in part on indexes associated with the ordered preamble resources.
29. The UE of claim 27, wherein the one or more processors, when generating the uplink RACH message, are configured to:
- order the multiple PRU configurations according to one or more criteria; and
 - select the PRU configuration associated with the payload from the multiple PRU configurations based at least in part on the ordering.
30. The UE of claim 29, wherein the one or more criteria used to order the multiple PRU configurations include one or more of an ascending modulation coding scheme or an ascending transport block size, based at least in part on the multiple PRU configurations overlapping in one or more of the time or frequency resources.
31. The UE of claim 29, wherein the one or more criteria used to order the multiple PRU configurations include one or more of ascending frequency occasions or ascending time occasions, based at least in part on the multiple PRU configurations not overlapping in the time or frequency resources.
32. The UE of claim 21, wherein the one or more processors, when generating the uplink RACH message, are configured to:
- generate a scrambling identifier for the payload according to a set of parameters that is based at least in part on an index associated with the preamble; and
 - scramble the payload using the scrambling identifier.
33. The UE of claim 32, wherein the set of parameters used to generate the scrambling identifier is further based at least in part on a random access radio network temporary identifier and a data scrambling identifier configured by the base station.

34. The UE of claim 32, wherein the scrambling identifier is generated based at least in part on a function that applies different weights to respective parameters of the set of parameters.

35. The UE of claim 32, wherein generating the uplink RACH message further includes generating a demodulation reference signal (DMRS) sequence associated with the uplink RACH message, wherein the DMRS sequence is scrambled based at least in part on the scrambling identifier for the payload and one or more time-dependent parameters associated with a PUSCH waveform used to transmit the payload.

36. The UE of claim 21, wherein the uplink RACH message is associated with a two-step RACH procedure.

37. The UE of claim 21, wherein the one or more processors are further configured to:
transmit, to the base station, the preamble associated with the uplink RACH message and the payload associated with the uplink RACH message, wherein the preamble and the payload are transmitted in separate symbols based at least in part on a time division multiplexing configuration, and wherein the payload carries at least one of a unique identifier associated with the UE, a medium access control layer control element, or user plane or control plane data.

38. The UE of claim 37, wherein the one or more processors are further configured to:
receive, from the base station, a downlink response message to the uplink RACH message, wherein the downlink response message includes a physical downlink control channel (PDCCH) and a physical downlink shared channel (PDSCH), and wherein the PDCCH includes a cyclic redundancy code (CRC) masked by a radio network temporary identifier (RNTI) and the PDSCH carries at least a portion of the identifier associated with the UE.

39. The UE of claim 38, wherein the RNTI masking the CRC of the PDCCH is a UE-specific identifier individually targeting the UE, and wherein the RNTI is based at least in part on one or more of a data scrambling identifier for a physical uplink shared channel, a demodulation reference signal scrambling identifier associated with the uplink RACH message, the preamble resource index, or the identifier associated with the UE that is carried in the payload of the uplink RACH message.

40. The UE of claim 38, wherein the RNTI masking the CRC of the PDCCH is a group identifier targeting a group of UEs sharing a particular RO, and wherein the RNTI is based at

least in part on one or more of a resource index associated with the particular RO shared by the group of UEs, a common time and frequency resource index associated with one or more PRUs shared by the group of UEs, a common demodulation reference signal resource index shared by the group of UEs, or a time and frequency resource index associated with the downlink response message.

41. A non-transitory computer-readable medium storing one or more instructions for wireless communication, the one or more instructions comprising:

one or more instructions that, when executed by one or more processors of a user equipment, cause the one or more processors to:

receive, from a base station, a random access channel (RACH) occasion (RO) configuration that includes information related to ordered preamble resources;

generate a preamble resource index according to a plurality of parameters that are selected based at least in part on the information in the RO configuration that relates to the ordered preamble resources; and

generate an uplink RACH message that includes a preamble based at least in part on the preamble resource index and a payload associated with a physical uplink shared channel resource unit mapped to the preamble resource index.

42. An apparatus for wireless communication, comprising:

means for receiving, from a base station, a random access channel (RACH) occasion (RO) configuration that includes information related to ordered preamble resources;

means for generating a preamble resource index according to a plurality of parameters that are selected based at least in part on the information in the RO configuration that relates to the ordered preamble resources; and

means for generating an uplink RACH message that includes a preamble based at least in part on the preamble resource index and a payload associated with a physical uplink shared channel resource unit mapped to the preamble resource index.