

CLAIMS

1. A method for wireless communications at a user equipment (UE), comprising: receiving, from a base station, a message indicating a plurality of transmission configuration options for retransmitting a first random access message of a random access procedure; determining to perform a set of retransmissions of the first random access message based at least in part on a retransmission trigger; identifying a transition trigger to transition from a first transmission configuration state to a second transmission configuration state; and transmitting, to the base station, a set of retransmissions of a second random access message according to the second transmission configuration state and based at least in part on the transition trigger, the plurality of transmission configuration options, and the retransmission trigger.

2. The method of claim 1, further comprising: determining to change at least one transmission configuration parameter from a first transmission of the first random access message to the set of retransmissions of the first random access message based at least in part on the plurality of transmission configuration options.

3. The method of claim 2, further comprising: outputting an indication of the determination to change the at least one transmission configuration parameter from the first transmission of the first random access message to the set of retransmissions of the first random access message.

4. The method of claim 1, further comprising: determining a plurality of transmission configuration states for transmission and retransmission of the first random access message based at least in part on the plurality of transmission configuration options, wherein each transmission configuration state of the plurality of transmission configuration states comprises a set of transmission configuration parameters, and wherein each transmission configuration state of the plurality of transmission configuration states differs by at least one transmission configuration parameter.

5. The method of claim 4, further comprising: selecting the first transmission configuration state from the plurality of transmission configuration states for a first transmission of the first random access message; transmitting, to the base station, the first transmission of the first random access message according to the first transmission

configuration state; and selecting the second transmission configuration state from the plurality of transmission configuration states for the retransmission of the first random access message, wherein the retransmission of the first random access message is transmitted according to the second transmission configuration state, wherein the second transmission configuration state is different than the first transmission configuration state.

6. The method of claim 4, further comprising: selecting the first transmission configuration state from the plurality of transmission configuration states for a first transmission of the first random access message; transmitting, to the base station, the first transmission of the first random access message according to the first transmission configuration state, wherein the retransmission of the first random access message is transmitted according to the first transmission configuration state based at least in part on a number of retransmissions of the first random access message being below a threshold number of retransmissions; determining to transmit a second retransmission of the first random access message based at least in part on the retransmission trigger; selecting the second transmission configuration state from the plurality of transmission configuration states for the second retransmission, wherein the second transmission configuration state is selected based at least in part on the number of retransmissions of the first random access message exceeding the threshold number of retransmissions; and transmitting, to the base station, the second retransmission of the first random access message according to the second transmission configuration state based at least in part on the determination to transmit the second retransmission, wherein the second transmission configuration state is different than the first transmission configuration state.

7. The method of claim 4, wherein the at least one transmission configuration parameter comprises a payload size, a modulation and coding scheme, a multiple-input multiple-output antenna configuration, a carrier, a frequency spectrum, a random access occasion index, a physical uplink channel resource unit group index, or a combination thereof.

8. The method of claim 1, wherein identifying the transition trigger comprises: receiving, from the base station, the transition trigger, wherein the transition trigger comprises an indication of a change of system loading information, a change of random access resource allocations, a change in synchronization signal block association rules, a

change of inter-cell interference measurement, a change of system information, or a combination thereof.

9. The method of claim 8, wherein the transition trigger is received in radio resource control signaling.

10. The method of claim 1, wherein identifying the transition trigger comprises: determining to transition from the first transmission configuration state to the second transmission configuration state based at least in part on a variation of a buffer status for the set of retransmissions from a first transmission, a variation of a power headroom value for the set of retransmissions from a first transmission, a quality of service handling for the set of retransmissions, or a combination thereof.

11. The method of claim 1, wherein retransmitting the first random access message further comprises: transmitting, to the base station, an indication of a log of transmission configuration state transitions for transmitting the first random access message, wherein the indication of the log of transmission configuration state transitions comprises transmission configuration parameters used for transmission of the first random access message prior to the set of retransmissions of the first random access message.

12. The method of claim 11, wherein the indication of the log of transmission configuration state transitions is indicated via a state-dependent group hopping of preamble sequences, a state-dependent group hopping of demodulation reference signal sequences, a state-dependent hopping of time-frequency resources used by a random access occasion, a state-dependent hopping of time-frequency resources used by a physical uplink channel resource unit, an uplink control information message, an embedded indication in a payload of the first random access message, or a combination thereof.

13. The method of claim 1, wherein the plurality of transmission configuration options comprises an indication of which transmission configuration parameters are reconfigurable by the UE for the set of retransmissions of the first random access message.

14. The method of claim 13, wherein the transmission configuration parameters comprise a preamble sequence for a random access occasion, an indication of the random access occasion, a payload content, a payload size, a physical uplink channel resource unit, a modulation and coding scheme, a carrier, a frequency spectrum, a beam, a

multi-panel or transmission/reception point configuration, a transmission/reception point, or a combination thereof.

15. The method of claim 1, wherein the retransmission trigger comprises not receiving a fallback random access response message within a random access response window, not receiving a success random access response message within the random access response window, a counter of a number of retransmissions of the first random access message being less than or equal to a threshold number of retransmissions, or a combination thereof.

16. The method of claim 1, wherein the message indicating the plurality of transmission configuration options comprises system information or radio resource control signaling.

17. The method of claim 1, wherein the random access procedure comprises a two-step random access procedure.

18. A method for wireless communications at a base station, comprising: transmitting, to a user equipment (UE), a message indicating a plurality of transmission configuration options for retransmitting a first random access message of a random access procedure; receiving, from the UE, a set of retransmissions of the first random access message, transmitted according to a first transmission configuration state; and receiving, from the UE, a set of retransmissions of a second random access message according to a second transmission configuration state and based at least in part on a transmission trigger, the plurality of transmission configuration options and a retransmission trigger.

19. The method of claim 18, further comprising: determining that at least one transmission configuration parameter for the set of retransmissions of the first random access message is different than a corresponding transmission configuration parameter for the set of retransmissions of the second random access message based at least in part on the plurality of transmission configuration options.

20. The method of claim 19, further comprising: receiving, from the UE, a second message indicating the at least one transmission configuration parameter for the set of retransmissions of the first random access message that is different than the corresponding

transmission configuration parameter for the set of retransmissions of the second random access message.

21. The method of claim 19, wherein the at least one transmission configuration parameter comprises a payload size, a modulation and coding scheme, a multiple-input multiple-output antenna configuration, a carrier, a frequency spectrum, a random access occasion index, a physical uplink channel resource unit group index, or a combination thereof.

22. The method of claim 18, wherein the second transmission configuration state being different by at least one transmission configuration parameter than the first transmission configuration state.

23. The method of claim 18, wherein the set of retransmissions of the first random access message is received according to the first transmission configuration state based at least in part on a number of retransmissions of the first random access message being below a threshold number of retransmissions.

24. The method of claim 23, wherein the second transmission configuration state is different by at least one transmission configuration parameter than the first transmission configuration state.

25. The method of claim 18, further comprising: transmitting, to the UE, a transition trigger to transition from the first transmission configuration state for the set of retransmissions of the first random access message to the second transmission configuration state for the set of retransmissions of the second random access message, wherein the transition trigger comprises an indication of a change of system loading information, a change of random access resource allocations, a change in synchronization signal block association rules, a change of inter-cell interference measurement, a change of system information, or a combination thereof.

26. The method of claim 25, wherein the transition trigger is transmitted in radio resource control signaling.

27. The method of claim 18, wherein receiving the set of retransmissions of the first random access message further comprises: receiving, from the UE, an indication of a log of transmission configuration state transitions the UE used for transmitting the first

random access message, wherein the indication of the log of transmission configuration state transitions comprises transmission configuration parameters the UE used for the set of retransmission of the first random access message prior to the set of retransmissions of the second random access message.

28. The method of claim 27, further comprising: combining at least a subset of the set of retransmissions of the first random access message based at least in part on the indication of the log of transmission configuration state transitions.

29. The method of claim 27, wherein the indication of the log of transmission configuration state transitions is indicated via a state-dependent group hopping of preamble sequences, a state-dependent group hopping of demodulation reference signal sequences, a state-dependent hopping of time-frequency resources used by a random access occasion, a state-dependent hopping of time-frequency resources used by a physical uplink channel resource unit, an uplink control information message, an embedded indication in a payload of the first random access message, or a combination thereof.

30. The method of claim 18, wherein the plurality of transmission configuration options comprises an indication of which transmission configuration parameters are reconfigurable by the UE for the set of retransmissions of the first random access message.

31. The method of claim 30, wherein the transmission configuration parameters comprise a preamble sequence for a random access occasion, an indication of the random access occasion, a payload content, a payload size, a physical uplink channel resource unit, a modulation and coding scheme, a carrier, a frequency spectrum, a beam, a multi-panel or transmission/reception point configuration, a transmission/reception point, or a combination thereof.

32. The method of claim 18, wherein the message indicating the plurality of transmission configuration options comprises system information or radio resource control signaling.

33. The method of claim 18, wherein the random access procedure comprises a two-step random access procedure.

34. An apparatus for wireless communications at a user equipment (UE), comprising: a processor, memory coupled with the processor; and instructions stored in the memory and executable by the processor to cause the apparatus to: receive, from a base station, a message indicating a plurality of transmission configuration options for retransmitting a first random access message of a random access procedure; determine to perform a set of retransmissions of the first random access message based at least in part on a retransmission trigger; identify a transition trigger to transition from a first transmission configuration state to a second transmission configuration state; and transmit, to the base station, a set of retransmissions of a second random access message according to the second transmission configuration state and based at least in part on the transition trigger, the plurality of transmission configuration options, and the retransmission trigger.

35. The apparatus of claim 34, wherein the instructions are further executable by the processor to cause the apparatus to: determine to change at least one transmission configuration parameter from a first transmission of the first random access message to the set of retransmissions of the first random access message based at least in part on the plurality of transmission configuration options.

36. The apparatus of claim 35, wherein the instructions are further executable by the processor to cause the apparatus to: outputting an indication of the determination to change the at least one transmission configuration parameter from the first transmission of the first random access message to the set of retransmissions of the first random access message.

37. The apparatus of claim 34, wherein the instructions are further executable by the processor to cause the apparatus to: determine a plurality of transmission configuration states for transmission and retransmission of the first random access message based at least in part on the plurality of transmission configuration options, wherein each transmission configuration state of the plurality of transmission configuration states comprises a set of transmission configuration parameters, and wherein each transmission configuration state of the plurality of transmission configuration states differs by at least one transmission configuration parameter.

38. The apparatus of claim 37, wherein the instructions are further executable by the processor to cause the apparatus to: select the first transmission configuration state from the plurality of transmission configuration states for a first transmission of the first

random access message; transmit, to the base station, the first transmission of the first random access message according to the first transmission configuration state; and select the second transmission configuration state from the plurality of transmission configuration states for the retransmission of the first random access message, wherein the retransmission of the first random access message is transmitted according to the second transmission configuration state, wherein the second transmission configuration state is different than the first transmission configuration state.

39. The apparatus of claim 37, wherein the instructions are further executable by the processor to cause the apparatus to: select the first transmission configuration state from the plurality of transmission configuration states for a first transmission of the first random access message; transmit, to the base station, the first transmission of the first random access message according to the first transmission configuration state, wherein the retransmission of the first random access message is transmitted according to the first transmission configuration state based at least in part on a number of retransmissions of the first random access message being below a threshold number of retransmissions; determine to transmit a second retransmission of the first random access message based at least in part on the retransmission trigger; select the second transmission configuration state from the plurality of transmission configuration states for the second retransmission, wherein the second transmission configuration state is selected based at least in part on the number of retransmissions of the first random access message exceeding the threshold number of retransmissions; and transmit, to the base station, the second retransmission of the first random access message according to the second transmission configuration state based at least in part on the determination to transmit the second retransmission, wherein the second transmission configuration state is different than the first transmission configuration state.

40. The apparatus of claim 37, wherein the at least one transmission configuration parameter comprises a payload size, a modulation and coding scheme, a multiple-input multiple-output antenna configuration, a carrier, a frequency spectrum, a random access occasion index, a physical uplink channel resource unit group index, or a combination thereof.

41. The apparatus of claim 34, wherein the instructions to identify the transition trigger are executable by the processor to cause the apparatus to: receive, from the base station, the transition trigger, wherein the transition trigger comprises an indication of a

change of system loading information, a change of random access resource allocations, a change in synchronization signal block association rules, a change of inter-cell interference measurement, a change of system information, or a combination thereof.

42. The apparatus of claim 41, wherein the transition trigger is received in radio resource control signaling.

43. The apparatus of claim 34, wherein the instructions to identify the transition trigger are executable by the processor to cause the apparatus to: determine to transition from the first transmission configuration state to the second transmission configuration state based at least in part on a variation of a buffer status for the set of retransmissions from a first transmission, a variation of a power headroom value for the set of retransmissions from a first transmission, a quality of service handling for the set of retransmissions, or a combination thereof.

44. The apparatus of claim 34, wherein the instructions to retransmit the first random access message further are executable by the processor to cause the apparatus to: transmit, to the base station, an indication of a log of transmission configuration state transitions for transmitting the first random access message, wherein the indication of the log of transmission configuration state transitions comprises transmission configuration parameters used for transmission of the first random access message prior to the set of retransmissions of the first random access message.

45. The apparatus of claim 44, wherein the indication of the log of transmission configuration state transitions is indicated via a state-dependent group hopping of preamble sequences, a state-dependent group hopping of demodulation reference signal sequences, a state-dependent hopping of time-frequency resources used by a random access occasion, a state-dependent hopping of time-frequency resources used by a physical uplink channel resource unit, an uplink control information message, an embedded indication in a payload of the first random access message, or a combination thereof.

46. The apparatus of claim 34, wherein the plurality of transmission configuration options comprises an indication of which transmission configuration parameters are reconfigurable by the UE for the set of retransmissions of the first random access message.

47. The apparatus of claim 46, wherein the transmission configuration parameters comprise a preamble sequence for a random access occasion, an indication of the random access occasion, a payload content, a payload size, a physical uplink channel resource unit, a modulation and coding scheme, a carrier, a frequency spectrum, a beam, a multi-panel or transmission/reception point configuration, a transmission/reception point, or a combination thereof.

48. The apparatus of claim 34, wherein the retransmission trigger comprises not receiving a fallback random access response message within a random access response window, not receiving a success random access response message within the random access response window, a counter of a number of retransmissions of the first random access message being less than or equal to a threshold number of retransmissions, or a combination thereof.

49. The apparatus of claim 34, wherein the message indicating the plurality of transmission configuration options comprises system information or radio resource control signaling.

50. The apparatus of claim 34, wherein the random access procedure comprises a two-step random access procedure.

51. An apparatus for wireless communications at a base station, comprising: a processor, memory coupled with the processor; and instructions stored in the memory and executable by the processor to cause the apparatus to: transmit, to a user equipment (UE), a message indicating a plurality of transmission configuration options for retransmitting a first random access message of a random access procedure; receive, from the UE, a set of retransmissions of the first random access message, transmitted according to a first transmission configuration state; and receive, from the UE, a a set of retransmissions of a second random access message according to a second transmission configuration state and based at least in part on a transmission trigger, the plurality of transmission configuration options and a retransmission trigger.

52. The apparatus of claim 51, wherein the instructions are further executable by the processor to cause the apparatus to: determine that at least one transmission configuration parameter for the set of retransmissions of the first random access message is different than a corresponding transmission configuration parameter for the set of

retransmissions of the second random access message based at least in part on the plurality of transmission configuration options.

53. The apparatus of claim 52, wherein the instructions are further executable by the processor to cause the apparatus to: receive, from the UE, a second message indicating the at least one transmission configuration parameter for the set of retransmissions of the first random access message that is different than the corresponding transmission configuration parameter for the set of retransmissions of the second random access message.

54. The apparatus of claim 52, wherein the at least one transmission configuration parameter comprises a payload size, a modulation and coding scheme, a multiple-input multiple-output antenna configuration, a carrier, a frequency spectrum, a random access occasion index, a physical uplink channel resource unit group index, or a combination thereof.

55. The apparatus of claim 51, wherein the second transmission configuration state being different by at least one transmission configuration parameter than the first transmission configuration state.

56. The apparatus of claim 51, wherein the set of retransmissions of the first random access message is received according to the first transmission configuration state based at least in part on a number of retransmissions of the first random access message being below a threshold number of retransmissions.

57. The apparatus of claim 56, wherein the second transmission configuration state is different by at least one transmission configuration parameter than the first transmission configuration state.

58. The apparatus of claim 51, wherein the instructions are further executable by the processor to cause the apparatus to: transmit, to the UE, a transition trigger to transition from the first transmission configuration state for the set of retransmissions of the first random access message to a second transmission configuration state for the set of retransmissions of a second random access message, wherein the transition trigger comprises an indication of a change of system loading information, a change of random access resource allocations, a change in synchronization signal block association rules, a change of inter-cell interference measurement, a change of system information, or a combination thereof.

59. The apparatus of claim 58, wherein the transition trigger is transmitted in radio resource control signaling.

60. The apparatus of claim 51, wherein the instructions to receive the retransmission of the first random access message further are executable by the processor to cause the apparatus to: receive, from the UE, an indication of a log of transmission configuration state transitions the UE used for transmitting the first random access message, wherein the indication of the log of transmission configuration state transitions comprises transmission configuration parameters the UE used for the set of retransmission of the first random access message prior to the set of retransmissions of a second random access message.

61. The apparatus of claim 60, wherein the instructions are further executable by the processor to cause the apparatus to: combine at least a subset of the set of retransmissions of the first random access message based at least in part on the indication of the log of transmission configuration state transitions.

62. The apparatus of claim 60, wherein the indication of the log of transmission configuration state transitions is indicated via a state-dependent group hopping of preamble sequences, a state-dependent group hopping of demodulation reference signal sequences, a state-dependent hopping of time-frequency resources used by a random access occasion, a state-dependent hopping of time-frequency resources used by a physical uplink channel resource unit, an uplink control information message, an embedded indication in a payload of the first random access message, or a combination thereof.

63. The apparatus of claim 51, wherein the plurality of transmission configuration options comprises an indication of which transmission configuration parameters are reconfigurable by the UE for the set of retransmissions of the first random access message.

64. The apparatus of claim 63, wherein the transmission configuration parameters comprise a preamble sequence for a random access occasion, an indication of the random access occasion, a payload content, a payload size, a physical uplink channel resource unit, a modulation and coding scheme, a carrier, a frequency spectrum, a beam, a multi-panel or transmission/reception point configuration, a transmission/reception point, or a combination thereof.

65. The apparatus of claim 51, wherein the message indicating the plurality of transmission configuration options comprises system information or radio resource control signaling.

66. The apparatus of claim 51, wherein the random access procedure comprises a two-step random access procedure.

67. An apparatus for wireless communications at a user equipment (UE), comprising: means for receiving, from a base station, a message indicating a plurality of transmission configuration options for retransmitting a first random access message of a random access procedure; means for determining to perform a set of retransmissions of the first random access message based at least in part on a retransmission trigger; means for identifying a transition trigger to transition from a first transmission configuration state to a second transmission configuration state; and means for transmitting, to the base station, a set of retransmissions of a second random access message according to the second transmission configuration state and based at least in part on the transition trigger, the plurality of transmission configuration options, and the retransmission trigger.

68. An apparatus for wireless communications at a base station, comprising: means for transmitting, to a user equipment (UE), a message indicating a plurality of transmission configuration options for retransmitting a first random access message of a random access procedure; means for receiving, from the UE, a set of retransmissions of the first random access message, transmitted according to a first transmission configuration state; and means for receiving, from the UE, a a set of retransmissions of a second random access message according to a second transmission configuration state and based at least in part on a transmission trigger, the plurality of transmission configuration options and a retransmission trigger.

69. A non-transitory computer-readable medium storing code for wireless communications at a user equipment (UE), the code comprising instructions executable by a processor to: receive, from a base station, a message indicating a plurality of transmission configuration options for retransmitting a first random access message of a random access procedure; determine to perform a set of retransmissions of the first random access message based at least in part on a retransmission trigger; identify a transition trigger to transition from a first transmission configuration state to a second transmission configuration state; and transmit, to the base station, a set of retransmissions of a second random access message

according to the second transmission configuration state and based at least in part on the transition trigger, the plurality of transmission configuration options, and the retransmission trigger.

70. A non-transitory computer-readable medium storing code for wireless communications at a base station, the code comprising instructions executable by a processor to: transmit, to a user equipment (UE), a message indicating a plurality of transmission configuration options for retransmitting a first random access message of a random access procedure; receive, from the UE, a set of retransmissions of the first random access message, transmitted according to a first transmission configuration state; and receive, from the UE, a set of retransmissions of a second random access message according to a second transmission configuration state and based at least in part on a transmission trigger, the plurality of transmission configuration options and a retransmission trigger.