

CLAIMS

1. A method for wireless communication at a user equipment, comprising:
 - determining a mapping between synchronization signal blocks and a random access message of a two-step random access procedure based at least in part on an indication, the random access message comprising a random access preamble and a random access payload;
 - determining, based at least in part on the mapping, an association between one or more beams carrying the synchronization signal blocks and one or more additional beams carrying the random access preamble and the random access payload of the random access message;
 - determining an association pattern period of the two-step random access procedure based at least in part on a second indication, wherein the association pattern period of the two-step random access procedure is based at least in part on a factor value of an association pattern period of a four-step random access procedure, the factor value comprising an integer value within a range configured by a network entity;
 - mapping resources of the synchronization signal blocks to one or more physical random access channel occasions of the random access preamble and one or more physical uplink shared channel resource units of the random access payload over physical random access channel configuration periods of the association pattern period of the two-step random access procedure; and
 - performing the two-step random access procedure with the network entity.

2. The method of claim 1, further comprising:
 - determining a second association between the one or more beams carrying the synchronization signal blocks and the one or more additional beams carrying the random access preamble and the random access payload of the random access message over additional physical random access channel configuration periods of a second association pattern period of the two-step random access procedure,
 - wherein the second association over the second association pattern period of the two-step random access procedure is different from the association over the association pattern period of the two-step random access procedure.

3. The method of claim 1, further comprising:

receiving, from the network entity, signaling including the indication comprising the association between the one or more beams carrying the synchronization signal blocks and the one or more additional beams carrying the random access preamble and the random access payload of the random access message, wherein the signaling comprises system information signaling or radio resource control signaling, or both.

4. The method of claim 1, further comprising:

determining the association between the one or more beams carrying the synchronization signal blocks and the one or more additional beams carrying the random access preamble and the random access payload of the random access message based at least in part on a physical random access channel occasion index of the one or more physical random access channel occasions, wherein the indication comprises the physical random access channel occasion index.

5. The method of claim 1, further comprising:

determining the association between the one or more beams carrying the synchronization signal blocks and the one or more additional beams carrying the random access preamble and the random access payload of the random access message based at least in part on a preamble sequence of the random access preamble, wherein the indication comprises the preamble sequence.

6. The method of claim 1, further comprising:

determining the association between the one or more beams carrying the synchronization signal blocks and the one or more additional beams carrying the random access preamble and the random access payload of the random access message based at least in part on a physical uplink shared channel resource unit index associated with the one or more physical uplink shared channel resource units of the random access payload, wherein the indication comprises the physical uplink shared channel resource unit index.

7. The method of claim 1, further comprising:

determining the association between the one or more beams carrying the synchronization signal blocks and the one or more additional beams carrying the random access

preamble and the random access payload of the random access message based at least in part on multiplexing uplink control information on one or more of the random access preamble and the random access payload of the random access message, wherein the indication comprises the multiplexing of the uplink control information.

8. The method of claim 1, wherein the random access preamble and the random access payload of the random access message are associated with different synchronization signal blocks of the synchronization signal blocks based at least in part on a duration of a guard period associated with the random access preamble and a gap period between the random access preamble and the random access payload.

9. The method of claim 1, further comprising:
determining that the one or more physical uplink shared channel resource units of the random access payload share one or more of time resources and frequency resources; and
determining a mapping between the one or more physical uplink shared channel resource units of the random access payload sharing one or more of the time resources and the frequency resources and a synchronization signal block of the synchronization signal blocks or a portion of synchronization signal blocks of the synchronization signal blocks, wherein the portion of synchronization signal blocks of the synchronization signal blocks are grouped.

10. The method of claim 9, wherein determining the mapping between the one or more physical uplink shared channel resource units of the random access payload sharing one or more of the time resources and the frequency resources, and the synchronization signal block of the synchronization signal blocks or the portion of synchronization signal blocks of the synchronization signal blocks comprises:

mapping the one or more physical uplink shared channel resource units of the random access payload sharing one or more of the time resources and the frequency resources to the synchronization signal block of the synchronization signal blocks based at least in part on an analog beam forming capability.

11. The method of claim 9, wherein determining the mapping between the one or more physical uplink shared channel resource units of the random access payload sharing one or more of the time resources and the frequency resources, and the synchronization signal block

of the synchronization signal blocks or the portion of synchronization signal blocks of the synchronization signal blocks comprises:

mapping the one or more physical uplink shared channel resource units of the random access payload sharing one or more of the time resources and the frequency resources to the portion of synchronization signal blocks of the synchronization signal blocks based at least in part on a digital beam forming capability.

12. The method of claim 1, further comprising:

determining that the one or more physical random access channel occasions of the random access preamble are shared with one or more additional random access preambles of a four-step random access procedure based at least in part on a UE capability, a random access procedure fallback capability, a load balancing capability, or a multiplexing of connection-free random access and contention-based random access, or any combination thereof.

13. The method of claim 1, further comprising:

determining that a number of synchronization signal blocks satisfies a threshold;

and

determining that the random access preamble of the random access message of the two-step random access procedure and a random access message of a four-step random access procedure are configured with different subsets of preamble sequences.

14. The method of claim 13, wherein an index of preamble sequences in each subset of the subsets of preamble sequences are consecutive.

15. The method of claim 13, wherein preamble sequences in each subset of the subsets of preamble sequences are nonoverlapping.

16. The method of claim 13, wherein the random access preamble of the random access message of the two-step random access procedure and the random access message of the four-step random access procedure have a same receive beam.

17. The method of claim 1, further comprising:

determining that number of synchronization signal blocks is greater than a threshold, wherein the number of synchronization signal blocks are mapped to same physical

random access channel occasions of the one or more physical random access channel occasions shared between the random access preamble of the two-step random access procedure and a random access message of a four-step random access procedure.

18. The method of claim 17, wherein the number of synchronization signal blocks have different transmit beams.

19. The method of claim 17, wherein the random access preamble of the two-step random access procedure and the random access message of the four-step random access procedure are mapped to different synchronization signal blocks of the number of synchronization signal blocks.

20. The method of claim 19, wherein a portion of the number of synchronization signal blocks mapped to the random access preamble of the two-step random access procedure are one or more of consecutive in time domain or nonconsecutive in the time domain.

21. The method of claim 19, wherein transmit beams mapped to the random access preamble of the two-step random access procedure and the random access message of the four-step random access procedure have a same or different preamble sequence size based at least in part on a spatial separation of the transmit beams mapped to the random access preamble of the two-step random access procedure and the random access message of the four-step random access procedure.

22. The method of claim 19, wherein the random access preamble of the random access message of the two-step random access procedure and the random access message of the four-step random access procedure have different receive beams.

23. The method of claim 1, wherein performing the two-step random access procedure comprises:

transmitting the random access message of the two-step random access procedure during an association pattern period to the network entity; and

retransmitting the random access message of the two-step random access procedure during the association pattern period based at least in part on a retransmission counter being less than a threshold.

24. The method of claim 23, further comprising:
performing a beam switch of the one or more additional beams carrying the random access preamble or the random access payload of the random access message, or both.

25. The method of claim 24, further comprising:
determining a change in a physical random access channel occasion index of the one or more physical random access channel occasions,
wherein performing the beam switch of the one or more additional beams carrying the random access preamble or the random access payload of the random access message, or both is based at least in part on the change in the physical random access channel occasion index.

26. The method of claim 24, further comprising:
determining a change in a physical uplink shared channel resource unit index associated with the one or more physical uplink shared channel resource units of the random access payload,
wherein performing the beam switch of the one or more additional beams carrying the random access preamble or the random access payload of the random access message, or both is based at least in part on the change in the physical uplink shared channel resource unit index associated with the one or more physical uplink shared channel resource units of the random access payload.

27. The method of claim 24, further comprising:
determining a change in a preamble sequence index of the random access preamble,
wherein performing the beam switch of the one or more additional beams carrying the random access preamble or the random access payload of the random access message, or both is based at least in part on the change in the random access preamble.

28. The method of claim 24, further comprising:

determining to multiplex uplink control information on one or more of the random access preamble and the random access payload of the random access message,

wherein performing the beam switch of the one or more additional beams carrying the random access preamble or the random access payload of the random access message, or both is based at least in part on multiplexing the uplink control information on one or more of the random access preamble and the random access payload of the random access message.

29. The method of claim 24, further comprising:

performing the beam switch of the one or more additional beams carrying the random access preamble or the random access payload of the random access message, or both jointly with an additional beam switch by the network entity of the one or more beams carrying the synchronization signal blocks.

30. The method of claim 24, wherein the beam switch is enabled based at least

in part on one or more of the association, the mapping, or a trigger indication comprising one or more of a preamble sequence, a reference signal, or uplink control information.

31. The method of claim 24, further comprising:

performing a random access fallback procedure or a random access switch procedure from the two-step random access procedure to a four-step random access procedure, wherein performing the beam switch is based at least in part on the random access fallback procedure or the random access switch procedure.

32. The method of claim 31, further comprising:

identifying a random access message of the four-step random access procedure based at least in part on the random access fallback procedure or the random access switch procedure, wherein performing the beam switch is based at least in part on control signaling comprising a downlink control information from the network entity, the beam switch comprising a switch of one or more of a transmit beam and a receive beam.

33. The method of claim 31, further comprising:

identifying a random access message of the four-step random access procedure based at least in part on the random access fallback procedure or the random access switch procedure, wherein performing the beam switch is based at least in part on preconfiguration information comprising the association.

34. The method of claim 23, wherein resources of the transmitting the random

access message of the two-step random access procedure during an association pattern period to the network entity are same resources of the retransmitting the random access message of the two-step random access procedure during the association pattern period based at least in part on the retransmission counter satisfying the threshold.

35. The method of claim 23, wherein resources of the transmitting the random

access message of the two-step random access procedure during an association pattern period to the network entity are different from resources of the retransmitting the random access message of the two-step random access procedure during the association pattern period based at least in part on the retransmission counter satisfying the threshold.

36. A method for wireless communication at a network entity, comprising:

determining a mapping between synchronization signal blocks and a random access message of a two-step random access procedure, the random access message comprising a random access preamble and a random access payload, and the mapping comprising an association between one or more beams carrying the synchronization signal blocks and one or more additional beams carrying the random access preamble and the random access payload of the random access message;

transmitting information to a user equipment comprising one or more of the mapping between the synchronization signal blocks and the random access message of the two-step random access procedure and the association between the one or more beams carrying the synchronization signal blocks and the one or more additional beams carrying the random access preamble and the random access payload of the random access message;

transmitting an indication to the user equipment indicating an association pattern period of the two-step random access procedure, wherein the association pattern period of the

two-step random access procedure is based at least in part on a factor value of an association pattern period of a four-step random access procedure, the factor value comprising an integer value within a range configured by the network entity;

mapping resources of the synchronization signal blocks to one or more physical random access channel occasions of the random access preamble and one or more physical uplink shared channel resource units of the random access payload over physical random access channel configuration periods of the association pattern period of the two-step random access procedure; and

performing the two-step random access procedure with the user equipment.

37. The method of claim 36 wherein transmitting the information to the user equipment comprises:

transmitting signaling comprising the information including one or more of the mapping between the synchronization signal blocks and the random access message of the two-step random access procedure and the association between the one or more beams carrying the synchronization signal blocks and the one or more additional beams carrying the random access preamble and the random access payload of the random access message, wherein the signal comprises system information signaling or radio resource control signaling, or both.

38. The method of claim 36, wherein the random access preamble and the random access payload of the random access message are associated with different synchronization signal blocks of the synchronization signal blocks based at least in part on a duration of a guard period associated with the random access preamble and a gap period between the random access preamble and the random access payload.

39. The method of claim 36, further comprising:

determining that one or more physical uplink shared channel resource units of the random access payload share one or more of time resources and frequency resources; and

determining a mapping between the one or more physical uplink shared channel resource units of the random access payload sharing one or more of the time resources and the frequency resources and a synchronization signal block of the synchronization signal blocks or a

portion of synchronization signal blocks of the synchronization signal blocks, wherein the portion of synchronization signal blocks of the synchronization signal blocks are grouped.

40. The method of claim 39, wherein determining the mapping between the one or more physical uplink shared channel resource units of the random access payload sharing one or more of the time resources and the frequency resources and the synchronization signal block of the synchronization signal blocks or the portion of synchronization signal blocks of the synchronization signal blocks comprises:

mapping the one or more physical uplink shared channel resource units of the random access payload sharing one or more of the time resources and the frequency resources to the synchronization signal block of the synchronization signal blocks based at least in part on an analog beam forming capability.

41. The method of claim 39, wherein determining the mapping between the one or more physical uplink shared channel resource units of the random access payload sharing the time resources and the synchronization signal block of the synchronization signal blocks or the portion of synchronization signal blocks of the synchronization signal blocks comprises:

mapping the one or more physical uplink shared channel resource units of the random access payload sharing the time resources to the portion of synchronization signal blocks of the synchronization signal blocks based at least in part on a digital beam forming capability.

42. The method of claim 36, further comprising:

determining that a number of synchronization signal blocks satisfies a threshold;

and

determining that the random access preamble of the random access message of the two-step random access procedure and a random access message of a four-step random access procedure have a same receive beam and are configured with different subsets of preamble sequences.

43. The method of claim 36, further comprising:

determining that a number of synchronization signal blocks is greater than a threshold, wherein the number of synchronization signal blocks are mapped to same physical random access channel occasions of the one or more physical random access channel occasions

shared between the random access preamble of the two-step random access procedure and a random access message of a four-step random access procedure.

44. The method of claim 43, wherein the number of synchronization signal blocks have different transmit beams.

45. The method of claim 43, wherein the random access preamble of the two-step random access procedure and the random access message of the four-step random access procedure are mapped to different synchronization signal blocks of the number of synchronization signal blocks.

46. The method of claim 45, wherein a portion of the number of synchronization signal blocks mapped to the random access preamble of the two-step random access procedure are one or more of consecutive in time domain or nonconsecutive in the time domain.

47. The method of claim 45, wherein the random access preamble of the random access message of the two-step random access procedure and the random access message of the four-step random access procedure have different receive beams.

48. The method of claim 36, further comprising:
performing a beam switch of the one or more additional beams carrying the random access preamble or the random access payload of the random access message, or both, wherein the one or more additional beams comprises receive beams.

49. The method of claim 36, further comprising:
performing a beam switch of the one or more additional beams carrying the random access preamble or the random access payload of the random access message, or both jointly with a beam switch of the one or more beams carrying the synchronization signal blocks, wherein the one or more additional beams comprises receive beams and the one or more beams carrying the synchronization signal blocks comprises transmit beams.

50. The method of claim 49, further comprising:

performing a random access fallback procedure or a random access switch procedure from the two-step random access procedure to a four-step random access procedure, wherein performing the beam switch is based at least in part on the random access fallback procedure or the random access switch procedure.

51. The method of claim 50 further comprising:

identifying a random access message of the four-step random access procedure based at least in part on the random access fallback procedure or the random access switch procedure; and

transmitting control signaling comprising downlink control information to the user equipment, wherein performing the beam switch is based at least in part on the control signaling, the beam switching comprising a switch of one or more of a transmit beam and a receive beam.

52. An apparatus for wireless communication, comprising:

a processor,

memory coupled with the processor; and

instructions stored in the memory and executable by the processor to cause the apparatus to:

determine a mapping between synchronization signal blocks and a random access message of a two-step random access procedure based at least in part on an indication, the random access message comprising a random access preamble and a random access payload;

determine, based at least in part on the mapping, an association between one or more beams carrying the synchronization signal blocks and one or more additional beams carrying the random access preamble and the random access payload of the random access message;

determine an association pattern period of the two-step random access procedure based at least in part on a second indication, wherein the association pattern period of the two-step random access procedure is based at least in part on a factor value

of an association pattern period of a four-step random access procedure, the factor value comprising an integer value within a range configured by a network entity;

map resources of the synchronization signal blocks to one or more physical random access channel occasions of the random access preamble and one or more physical uplink shared channel resource units of the random access payload over physical random access channel configuration periods of the association pattern period of the two-step random access procedure; and

perform the two-step random access procedure with the network entity.

53. An apparatus for wireless communication, comprising:

a processor,

memory coupled with the processor; and

instructions stored in the memory and executable by the processor to cause the

apparatus to:

determine a mapping between synchronization signal blocks and a random access message of a two-step random access procedure, the random access message comprising a random access preamble and a random access payload, and the mapping comprising an association between one or more beams carrying the synchronization signal blocks and one or more additional beams carrying the random access preamble and the random access payload of the random access message;

transmit information to a user equipment comprising one or more of the mapping between the synchronization signal blocks and the random access message of the two-step random access procedure and the association between the one or more beams carrying the synchronization signal blocks and the one or more additional beams carrying the random access preamble and the random access payload of the random access message;

transmit an indication to the user equipment indicating the association pattern period of the two-step random access procedure, wherein the association pattern period of the two-step random access procedure is based at least in part on a factor value of an association pattern period of a four-step random access procedure, the factor value comprising an integer value within a range configured by the apparatus;

map resources of the synchronization signal blocks to one or more physical random access channel occasions of the random access preamble and one or more physical uplink shared channel resource units of the random access payload over physical random access channel configuration periods of the association pattern period of the two-step random access procedure; and

perform the two-step random access procedure with the user equipment according to the mapping.

54. An apparatus for wireless communication, comprising:

means for determining a mapping between synchronization signal blocks and a random access message of a two-step random access procedure based at least in part on an indication, the random access message comprising a random access preamble and a random access payload;

means for determining, based at least in part on the mapping, an association between one or more beams carrying the synchronization signal blocks and one or more additional beams carrying the random access preamble and the random access payload of the random access message;

means for determining an association pattern period of the two-step random access procedure based at least in part on a second indication, wherein the association pattern period of the two-step random access procedure is based at least in part on a factor value of an association pattern period of a four-step random access procedure, the factor value comprising an integer value within a range configured by a network entity;

means for mapping resources of the synchronization signal blocks to one or more physical random access channel occasions of the random access preamble and one or more physical uplink shared channel resource units of the random access payload over physical random access channel configuration periods of the association pattern period of the two-step random access procedure; and

means for performing the two-step random access procedure with the network entity.

55. An apparatus for wireless communication, comprising:

means for determining a mapping between synchronization signal blocks and a random access message of a two-step random access procedure, the random access message comprising a random access preamble and a random access payload, and the mapping comprising an association between one or more beams carrying the synchronization signal blocks and one or more additional beams carrying the random access preamble and the random access payload of the random access message;

means for transmitting information to a user equipment comprising one or more of the mapping between the synchronization signal blocks and the random access message of the two-step random access procedure and the association between the one or more beams carrying the synchronization signal blocks and the one or more additional beams carrying the random access preamble and the random access payload of the random access message;

means for transmitting an indication to the user equipment indicating an association pattern period of the two-step random access procedure, wherein the association pattern period of the two-step random access procedure is based at least in part on a factor value of an association pattern period of a four-step random access procedure, the factor value comprising an integer value within a range configured by the apparatus;

means for mapping resources of the synchronization signal blocks to one or more physical random access channel occasions of the random access preamble and one or more physical uplink shared channel resource units of the random access payload over physical random access channel configuration periods of the association pattern period of the two-step random access procedure; and

means for performing the two-step random access procedure with the user equipment according to the mapping.

56. A non-transitory computer-readable medium storing code for wireless communication at a user equipment, the code comprising instructions executable by a processor to:

determine a mapping between synchronization signal blocks and a random access message of a two-step random access procedure based at least in part on an indication, the random access message comprising a random access preamble and a random access payload;

determine, based at least in part on the mapping, an association between one or more beams carrying the synchronization signal blocks and one or more additional beams carrying the random access preamble and the random access payload of the random access message;

determine an association pattern period of the two-step random access procedure based at least in part on a second indication, wherein the association pattern period of the two-step random access procedure is based at least in part on a factor value of an association pattern period of a four-step random access procedure, the factor value comprising an integer value within a range configured by a network entity;

map resources of the synchronization signal blocks to one or more physical random access channel occasions of the random access preamble and one or more physical uplink shared channel resource units of the random access payload over physical random access channel configuration periods of the association pattern period of the two-step random access procedure; and

perform the two-step random access procedure with the network entity.

57. A non-transitory computer-readable medium storing code for wireless communication at a network entity, the code comprising instructions executable by a processor to:

determine a mapping between synchronization signal blocks and a random access message of a two-step random access procedure, the random access message comprising a random access preamble and a random access payload, and the mapping comprising an association between one or more beams carrying the synchronization signal blocks and one or more additional beams carrying the random access preamble and the random access payload of the random access message;

transmit information to a user equipment comprising one or more of the mapping between the synchronization signal blocks and the random access message of the two-step random access procedure and the association between the one or more beams carrying the synchronization signal blocks and the one or more additional beams carrying the random access preamble and the random access payload of the random access message;

transmit an indication to the user equipment indicating an association pattern period of the two-step random access procedure, wherein the association pattern period of the

two-step random access procedure is based at least in part on a factor value of an association pattern period of a four-step random access procedure, the factor value comprising an integer value within a range configured by the network entity;

map resources of the synchronization signal blocks to one or more physical random access channel occasions of the random access preamble and one or more physical uplink shared channel resource units of the random access payload over physical random access channel configuration periods of the association pattern period of the two-step random access procedure; and

perform the two-step random access procedure with the user equipment according to the mapping.

58. The method of claim 1, wherein the second indication indicates the association pattern period of the two-step random access procedure from a set of association pattern periods.