

CLAIMS

1. A method of wireless communication of a user equipment (UE), comprising:
 - determining, based on a random access channel (RACH) subcarrier spacing and a data tone subcarrier spacing, a number of RACH tones allocated for a transmission of a RACH preamble sequence, wherein the RACH subcarrier spacing is one of a plurality of RACH subcarrier spacings and the data tone subcarrier spacing is one of a plurality of data tone subcarrier spacings, and the number of RACH tones allocated for a transmission of a RACH preamble sequence correspond to a ratio between the RACH subcarrier spacing and the data tone subcarrier spacing; and
 - transmitting the RACH preamble sequence in RACH resources within the determined number of RACH tones.
2. The method of claim 1, wherein the RACH resources include the RACH preamble sequence and RACH guard tones.
3. The method of claim 1, wherein the determined number of RACH tones is N_1 when the RACH subcarrier spacing is S_1 and is N_2 when the RACH subcarrier spacing is S_2 , where $N_1 > N_2$ and $S_1 > S_2$.
4. The method of claim 1, wherein the data tone subcarrier spacing is S_s and the RACH tone spacing S_t , where $S_s > S_t$, and the determined number of RACH tones allocated for the RACH resources is equal to $12 \cdot N_{RB} \cdot S_s / S_t$, where N_{RB} is the number of RBs within the allocated RACH resources and $N_{RB} \leq 5$ and is an integer.
5. The method of claim 1, further comprising rate matching uplink data around the allocated RACH resources, wherein the rate matched uplink data is transmitted concurrently with the RACH preamble sequence.

6. The method of claim 1, further comprising puncturing uplink data with the RACH resources including the RACH preamble sequence and RACH guard tones, wherein the punctured uplink data is transmitted concurrently with the RACH preamble sequence.

7. The method of claim 6, wherein a number of guard tones within the RACH resources increases as the RACH subcarrier spacing increases, the number of guard tones being equal to the determined number of RACH tones minus the RACH preamble sequence length.

8. The method of claim 1, wherein a RACH preamble sequence length for the RACH preamble sequence is fixed for various RACH subcarrier spacings.

9. The method of claim 1, further comprising receiving information from a base station indicating a number of RACH tones to allocate to the RACH resources.

10. The method of claim 9, wherein the information is received through one or more of a primary synchronization signal (PSS), a secondary synchronization signal (SSS), a physical broadcast channel (PBCH), demodulation reference signals (DMRS) of the PBCH, remaining minimum system information (RMSI), other system information (OSI), a physical downlink control channel (PDCCH), a radio resource control (RRC) message, a handover message, or a system information block (SIB).

11. A method of wireless communication of a user equipment (UE), comprising:

determining, based on a subcarrier spacing within resource blocks (RBs) of random access channel (RACH) resources and based on a RACH tone spacing within each subcarrier of the RBs, a number of RACH tones for rate matching or puncturing in association with the RACH resources and uplink data, the number of RACH tones for rate matching or puncturing being equal to a number of RACH tones of the RACH resources plus x additional RACH tones, where $x \geq 96$ for a first subcarrier spacing S_1 and $x = 0$ for a second subcarrier spacing S_2 , where $S_1 > S_2$; and

transmitting a RACH preamble sequence in the RACH resources.

12. The method of claim 11, wherein the determined number of RACH tones for rate matching or puncturing is 960 for the first subcarrier spacing S_1 and is 864 for the second subcarrier spacing S_2 .

13. The method of claim 11, wherein the RACH tone spacing is one of 1.25 kHz or 5 kHz, and the subcarrier spacing is one of 15 kHz or 60 kHz.

14. The method of claim 11, wherein a RACH preamble sequence length for the RACH preamble sequence is fixed for various RACH subcarrier spacings.

15. An apparatus for wireless communication, comprising:

a memory; and

at least one processor coupled to the memory and configured to:

determine, based on a random access channel (RACH) subcarrier spacing and a data tone subcarrier spacing, a number of RACH tones allocated for a transmission of a RACH preamble sequence, wherein the RACH subcarrier spacing is one of a plurality of RACH subcarrier spacings and the data tone subcarrier spacing is one of a plurality of data tone subcarrier spacings, and the number of RACH tones allocated for a transmission of a RACH preamble sequence corresponds to a ratio between the RACH subcarrier spacing and the data tone subcarrier spacing; and

transmit the RACH preamble sequence in RACH resources within the determined number of RACH tones.

16. The apparatus of claim 15, wherein the RACH resources include the RACH preamble sequence and RACH guard tones.

17. The apparatus of claim 16, wherein the RACH guard tones comprise at least 6.5 subcarriers within the RBs of the RACH resources when the RACH subcarrier spacing is S_1 and comprise at least 2 subcarriers within the RBs of the RACH resources when the RACH subcarrier spacing is S_2 .

18. The apparatus of claim 15, wherein the determined number of RACH tones is N_1 when the RACH subcarrier spacing is S_1 and is N_2 when the RACH subcarrier spacing is S_2 , where $N_1 > N_2$ and $S_1 > S_2$.

19. The apparatus of claim 15, wherein the data tone subcarrier spacing is S_s and the RACH tone spacing S_t , where $S_s > S_t$, and the determined number of RACH tones allocated for the RACH resources is equal to $12 \cdot N_{RB} \cdot S_s / S_t$, where N_{RB} is the number of RBs within the allocated RACH resources and $N_{RB} \leq 5$ and is an integer.

20. The apparatus of claim 15, further comprising rate matching uplink data around the allocated RACH resources, wherein the rate matched uplink data is transmitted concurrently with the RACH preamble sequence.

21. The apparatus of claim 15, wherein the at least one processor and memory are further configured to puncture uplink data with the RACH resources including the RACH preamble sequence and RACH guard tones, wherein the punctured uplink data is transmitted concurrently with the RACH preamble sequence.

22. The apparatus of claim 15, wherein a RACH preamble sequence length for the RACH preamble sequence is fixed for various RACH subcarrier spacings.

23. The apparatus of claim 22, wherein a number of guard tones within the RACH resources increases as the RACH subcarrier spacing increases, the number of guard tones being equal to the determined number of RACH tones minus the RACH preamble sequence length.

24. The apparatus of claim 15, wherein the at least one processor is further configured to receive information from a base station indicating a number of RACH tones to allocate to the RACH resources.

25. The apparatus of claim 24, wherein the information is received through one or more of a primary synchronization signal (PSS), a secondary synchronization signal (SSS), a physical

broadcast channel (PBCH), demodulation reference signals (DMRS) of the PBCH, remaining minimum system information (RMSI), other system information (OSI), a physical downlink control channel (PDCCH), a radio resource control (RRC) message, a handover message, or a system information block (SIB).

26. A non-transitory computer-readable medium (CRM) storing computer executable code, comprising code to:

determine, based on a random access channel (RACH) subcarrier spacing and a data tone subcarrier spacing, a number of RACH tones allocated for a transmission of a RACH preamble sequence, wherein the RACH subcarrier spacing is one of a plurality of RACH subcarrier spacings and the data tone subcarrier spacing is one of a plurality of data tone subcarrier spacings, and the number of RACH tones allocated for a transmission of a RACH preamble sequence corresponds to a ratio between the RACH subcarrier spacing and the data tone subcarrier spacing; and

transmit the RACH preamble sequence in RACH resources within the determined number of RACH tones.

27. The non-transitory CRM of claim 26, wherein the RACH resources include the RACH preamble sequence and RACH guard tones.

28. The non-transitory CRM of claim 27, wherein the RACH guard tones comprise at least 6.5 subcarriers within the RBs of the RACH resources when the RACH subcarrier spacing is S_1 and comprise at least 2 subcarriers within the RBs of the RACH resources when the subcarrier spacing is S_2 .

29. The non-transitory CRM of claim 26, wherein the determined number of RACH tones is N_1 when the RACH subcarrier spacing is S_1 and is N_2 when the RACH subcarrier spacing is S_2 , where $N_1 > N_2$ and $S_1 > S_2$.

30. The non-transitory CRM of claim 26, wherein the data tone subcarrier spacing is S_s and the RACH tone spacing S_t , where $S_s > S_t$, and the determined number of RACH tones allocated for

the RACH resources is equal to $12 \cdot N_{RB} \cdot S_s / S_t$, where N_{RB} is the number of RBs within the allocated RACH resources and $N_{RB} \leq 5$ and is an integer.

31. The non-transitory CRM of claim 26, further comprising code to rate match uplink data around the allocated RACH resources, wherein the rate matched uplink data is transmitted concurrently with the RACH preamble sequence.

32. The non-transitory CRM of claim 26, further comprising code to puncture uplink data with the RACH resources including the RACH preamble sequence and RACH guard tones, wherein the punctured uplink data is transmitted concurrently with the RACH preamble sequence.

33. The non-transitory CRM of claim 26, wherein a RACH preamble sequence length for the RACH preamble sequence is fixed for various RACH subcarrier spacings.

34. The non-transitory CRM of claim 33, wherein a number of guard tones within the RACH resources increases as the RACH subcarrier spacing increases, the number of guard tones being equal to the determined number of RACH tones minus the RACH preamble sequence length.

35. The non-transitory CRM of claim 26, further comprising code to receive information from a base station indicating a number of RACH tones to allocate to the RACH resources.

36. The non-transitory CRM of claim 35, wherein the information is received through one or more of a primary synchronization signal (PSS), a secondary synchronization signal (SSS), a physical broadcast channel (PBCH), demodulation reference signals (DMRS) of the PBCH, remaining minimum system information (RMSI), other system information (OSI), a physical downlink control channel (PDCCH), a radio resource control (RRC) message, a handover message, or a system information block (SIB).