

CLAIMS

What is claimed is:

1. A method for wireless communication, comprising:
receiving a first synchronization signal for synchronizing with a cell, the first synchronization signal transmitted by a base station serving the cell according to a first periodicity;
receiving, subsequent to the synchronizing, a second synchronization signal for resynchronizing with the cell, the second synchronization signal transmitted by the base station according to a second periodicity, wherein the second synchronization signal comprises a plurality of repetitions of a first sequence that is based at least in part on a cell identifier of the cell; and
communicating over the cell with the base station based at least in part on the resynchronizing.
2. The method of claim 1, wherein the second synchronization signal comprises a plurality of repetitions of a second sequence, and wherein the plurality of repetitions of the first sequence and the plurality of repetitions of the second sequence are transmitted according to a binary sequence.
3. The method of claim 2, wherein the first sequence and the second sequence have low absolute value of cross-correlation with each other.
4. The method of claim 2, wherein the second sequence corresponds to a complex conjugate of the first sequence.
5. The method of claim 2, wherein the second sequence corresponds to a phase-rotated version of the first sequence.
6. The method of claim 2, wherein the binary sequence is based at least in part on a length of the first sequence, or a length of the second synchronization signal, or the cell identifier, or a combination thereof.

14. The method of claim 1, wherein the second synchronization signal spans a subset of a plurality of physical resource blocks (PRBs) corresponding to a bandwidth of a narrowband protocol type.

15. The method of claim 14, wherein a transmission power associated with the second synchronization signal is increased relative to a transmission power associated with the first synchronization signal by a ratio of a first number of PRBs in the plurality of PRBs to a second number of PRBs in the subset of the plurality of PRBs.

16. The method of claim 14, wherein the subset of the plurality of PRBs correspond to a contiguous set of PRBs.

17. The method of claim 14, wherein the subset of the plurality of PRBs correspond to a non-contiguous set of PRBs.

18. The method of claim 1, further comprising:
determining the cell identifier of the base station from the first synchronization signal; and

correlating the second synchronization signal for the resynchronizing using a representation of the first sequence determined based at least in part on the cell identifier.

19. The method of claim 1, further comprising:
receiving system information associated with the cell, the system information indicating at least one of a presence of the second synchronization signal, timing information for the second synchronization signal, a length of the second synchronization signal, a frequency offset and/or a frequency location for the second synchronization signal, a transmit power for the second synchronization signal, a bandwidth of the second synchronization signal, a hopping pattern for the second synchronization signal, a multiplicative factor for the second periodicity, or an overhead percentage.

20. The method of claim 19, further comprising:
determining the second periodicity based at least in part on an association between the length of the second synchronization signal received in the system information and the second periodicity.

21. The method of claim 20, wherein the association between the length of the second synchronization signal received in the system information and the second periodicity is determined based at least in part on the multiplicative factor.

22. The method of claim 19, further comprising:
determining the length of the second synchronization signal based at least in part on an association between the second periodicity received in the system information and the length of the second synchronization signal.

23. The method of claim 22, wherein the association between the second periodicity received in the system information and the length of the second synchronization signal is determined based at least in part on the overhead percentage.

24. The method of claim 1, wherein at least one of a plurality of scheduled subframes for the second synchronization signal coincides with a subframe that is restricted for transmission of the second synchronization signal, and wherein the receiving the second synchronization signal comprises:

modifying the plurality of scheduled subframes for the receiving the second synchronization signal.

25. The method of claim 24, wherein the restricted subframe comprises one of a multicast subframe, a machine-type communication (MTC) invalid subframe, a time division duplex (TDD) uplink subframe, or a TDD special subframe.

26. The method of claim 24, wherein the modifying the plurality of scheduled subframes comprises selecting a modification action from the group consisting of postponing the at least one of the plurality of scheduled subframes to a next subframe after the restricted subframe, suppressing reception of the at least one of the plurality of scheduled subframes for the restricted subframe, and receiving a portion of the at least one of the plurality of scheduled subframes in the restricted subframe.

27. The method of claim 26, wherein the selecting the modification action is based at least in part on a TDD special subframe configuration.

28. The method of claim 1, wherein the second synchronization signal is punctured by at least one of a reference signal, the first synchronization signal, or a broadcast channel.

29. The method of claim 1, further comprising:
receiving, from the base station, a resynchronization signal configuration for a neighbor cell, the resynchronization signal configuration comprising at least one of a presence of a resynchronization signal for the neighbor cell, a periodicity for the resynchronization signal, a length of the resynchronization signal, a timing offset for the resynchronization signal, a frequency offset for the resynchronization signal, a transmit power for the resynchronization signal, a bandwidth of the resynchronization signal, or a hopping pattern for the resynchronization signal.

30. The method of claim 29, wherein the resynchronization signal configuration is received in system information or in dedicated signaling from the base station.

31. The method of claim 1, further comprising:
transitioning, subsequent to the synchronizing, out of a connected mode with the base station.

32. The method of claim 1, wherein the first sequence corresponds to a pseudo-noise sequence, a Zadoff-Chu sequence, or a result of a Kronecker product of a subsequence with a binary sequence.

33. The method of claim 31, wherein the subsequence corresponds to a pseudo-noise sequence or a Zadoff-Chu sequence and the binary sequence corresponds to a maximum length sequence, a Barker code, or a Gold sequence.

34. The method of claim 1, further comprising:
receiving a second instance of the first synchronization signal for the resynchronizing with the cell based at least in part on phase or timing information determined from the second synchronization signal.

35. The method of claim 1, wherein a length of the first sequence is based at least in part on a length of the second synchronization signal, and wherein the length of the second synchronization signal is a multiple of the length of the first sequence.

36. The method of claim 35, wherein an association between the length of the first sequence and the length of the second synchronization signal is identified from a look-up table.

37. A method for wireless communication, comprising:
transmitting, by a base station serving a cell, a first synchronization signal for the cell, the first synchronization signal transmitted according to a first periodicity;
transmitting a second synchronization signal for the cell, the second synchronization signal transmitted according to a second periodicity, wherein the second synchronization signal comprises a plurality of repetitions of a first sequence that is based at least in part on a cell identifier of the cell; and
communicating with at least one user equipment (UE) over the cell based at least in part on the transmission of the first synchronization signal or the second synchronization signal.

38. The method of claim 37, further comprising:
transmitting the first subsequence via a first antenna port and the second subsequence via a second antenna port.

39. The method of claim 38, wherein the second synchronization signal comprises a plurality of repetitions of a second sequence, and wherein the plurality of repetitions of the first sequence and the plurality of repetitions of the second sequence are transmitted according to a binary sequence.

40. The method of claim 38, wherein the first sequence and the second sequence have low absolute value of cross-correlation with each other.

41. The method of claim 38, wherein the second sequence corresponds to a complex conjugate of the first sequence.

42. The method of claim 38, wherein the binary sequence is based at least in part on a length of the first sequence, or a length of the second synchronization signal, or the cell identifier, or a combination thereof.

43. The method of claim 38, wherein a sequence type of the binary sequence is based at least in part on a length of the first sequence or a length of the second synchronization signal, and wherein the sequence type corresponds to a Gold sequence, an m-sequence, or a computer-generated sequence with minimum sidelobe amplitude in an autocorrelation function.

44. The method of claim 38, further comprising:
transmitting the first sequence via a first antenna port and the second sequence via a second antenna port.

45. The method of claim 37, wherein the first sequence comprises a first subsequence and a second subsequence.

46. The method of claim 45, wherein the second subsequence corresponds to a complex conjugate of the first subsequence.

47. The method of claim 37, further comprising:
transmitting a third synchronization signal for the cell subsequent to the second synchronization signal, the third synchronization signal having a sequence length longer than a sequence length of the first sequence.

48. The method of claim 47, wherein the sequence length of the third synchronization signal is shorter than a sequence length of the second synchronization signal.

49. The method of claim 37, wherein the first synchronization signal spans a plurality of physical resource blocks (PRBs) and the second synchronization signal spans the plurality of PRBs.

50. The method of claim 37, wherein the first synchronization signal spans a plurality of physical resource blocks (PRBs) and the second synchronization signal spans a subset of the plurality of PRBs.

51. The method of claim 50, wherein a transmission power associated with the second synchronization signal is increased relative to a transmission power associated with the first synchronization signal by a ratio of a first number of PRBs in the plurality of PRBs to a second number of PRBs in the subset of the plurality of PRBs.

52. The method of claim 50, wherein the subset of the plurality of PRBs correspond to a contiguous set of PRBs.

53. The method of claim 50, wherein the subset of the plurality of PRBs correspond to a non-contiguous set of PRBs.

54. The method of claim 37, further comprising:
transmitting system information associated with the cell, the system information indicating at least one of a presence of the second synchronization signal, timing information for the second synchronization signal, a length of the second synchronization signal, a frequency offset and/or a frequency location for the second synchronization signal, a transmit power for the second synchronization signal, a bandwidth of the second synchronization signal, a hopping pattern for the second synchronization signal, a multiplicative factor for the second periodicity, or an overhead percentage.

55. The method of claim 54, further comprising:
determining the second periodicity based at least in part on an association between the length of the second synchronization signal indicated in the system information and the second periodicity, wherein the association between the length of the second synchronization signal received in the system information and the second periodicity is determined based at least in part on the multiplicative factor.

56. The method of claim 55, further comprising:
determining the length of the second synchronization signal based at least in part on an association between the second periodicity indicated in the system information and

the length of the second synchronization signal, wherein the association between the second periodicity received in the system information and the length of the second synchronization signal is determined based at least in part on the overhead percentage.

57. The method of claim 37, wherein at least one of a plurality of scheduled subframes for the second synchronization signal coincides with a subframe that is restricted for of the second synchronization signal, and wherein the transmitting the second synchronization signal comprises:

modifying the plurality of scheduled subframes for the transmitting the second synchronization signal.

58. The method of claim 57, wherein the restricted subframe comprises one of a multicast subframe, a machine-type communication (MTC) invalid subframe, a time division duplex (TDD) uplink subframe, or a TDD special subframe.

59. The method of claim 57, wherein the modifying the plurality of scheduled subframes comprises selecting a modification action from the group consisting of postponing the at least one of the plurality of scheduled subframes to a next subframe after the restricted subframe, suppressing transmission of the at least one of the plurality of scheduled subframes for the restricted subframe, and transmitting a portion of the at least one of the plurality of scheduled subframes in the restricted subframe.

60. The method of claim 59, wherein the selecting the modification action is based at least in part on a TDD special subframe configuration.

61. The method of claim 37, further comprising:
puncturing the second synchronization signal with at least one of a reference signal, the first synchronization signal, or a broadcast channel.

62. The method of claim 37, further comprising:
transmitting, to the at least one UE, a resynchronization signal configuration for a neighbor cell, the resynchronization signal configuration comprising at least one of a presence of a resynchronization signal for the neighbor cell, a periodicity for the resynchronization signal, a length of the resynchronization signal, a timing offset for the

resynchronization signal, a frequency offset for the resynchronization signal, a transmit power for the resynchronization signal, a bandwidth of the resynchronization signal, or a hopping pattern for the resynchronization signal.

63. The method of claim 62, wherein the resynchronization signal configuration is transmitted in system information or in dedicated signaling from the base station to the at least one UE.

64. The method of claim 37, wherein the first sequence corresponds to a pseudo-noise sequence, a Zadoff-Chu sequence, or a result of a Kronecker product of a subsequence with a binary sequence.

65. The method of claim 64, wherein the subsequence corresponds to a pseudo-noise sequence or a Zadoff-Chu sequence and the binary sequence corresponds to a maximum length sequence, a Barker code, or a Gold sequence.

66. The method of claim 37, wherein identifying a length of the first sequence is based at least in part on a length of the second synchronization signal, and wherein the length of the second synchronization signal is a multiple of the length of the first sequence.

67. The method of claim 66, wherein an association between the length of the first sequence and the length of the second synchronization signal is identified from a look-up table.

68. An apparatus for wireless communication, comprising:
a processor;
memory in electronic communication with the processor; and
instructions stored in the memory and executable by the processor to cause the apparatus to:

receive a first synchronization signal for synchronizing with a cell, the first synchronization signal transmitted by a base station serving the cell according to a first periodicity;

receive, subsequent to the synchronizing, a second synchronization signal for resynchronizing with the cell, the second synchronization signal transmitted by the base station according to a second periodicity, wherein the second synchronization signal comprises a plurality of repetitions of a first sequence that is based at least in part on a cell identifier of the cell; and

communicate over the cell with the base station based at least in part on the resynchronizing.

69. The apparatus of claim 68, wherein the second synchronization signal comprises a plurality of repetitions of a second sequence, and wherein the plurality of repetitions of the first sequence and the plurality of repetitions of the second sequence are transmitted according to a binary sequence.

70. The apparatus of claim 69, wherein the first sequence and the second sequence have low absolute value of cross-correlation with each other.

71. An apparatus for wireless communication, comprising:
a processor;
memory in electronic communication with the processor; and
instructions stored in the memory and executable by the processor to cause the apparatus to:

transmit, by a base station serving a cell, a first synchronization signal for the cell, the first synchronization signal transmitted according to a first periodicity;

transmit a second synchronization signal for the cell, the second synchronization signal transmitted according to a second periodicity, wherein the second synchronization signal comprises a plurality of repetitions of a first sequence that is based at least in part on a cell identifier of the cell; and

communicate with at least one user equipment (UE) over the cell based at least in part on the transmission of the first synchronization signal or the second synchronization signal.

72. A method for wireless communication at a user equipment (UE), comprising:

receiving a signal mapped to a first subset of resource elements of a time-frequency resource block and a set of reference signals mapped to a second subset of the resource elements of the time-frequency resource block, wherein the first subset of resource elements comprise a subset of resource elements of a first symbol period of the time-frequency resource block, and each resource element of a second symbol period of the time-frequency resource block;

identifying a power ratio between each of the first subset of resource elements and the set of reference signals based at least in part on a number of antenna ports of the set of reference signals; and

demodulating the signal based at least in part on the power ratio.

73. The method of claim 72, wherein the identifying the power ratio comprises:

evaluating a function of a first power ratio between the set of reference signals and resource elements of a data channel for the first symbol period and a second power ratio between the set of reference signals and resource elements of the data channel for the second symbol period.

74. The method of claim 73, wherein the function comprises normalizing the second power ratio by the first power ratio.

75. The method of claim 73, wherein the function comprises a minimum of the first power ratio and the second power ratio.

76. The method of claim 73, wherein the function comprises a maximum of the first power ratio and the second power ratio.

77. The method of claim 73, wherein the function comprises a sum of a product of the first power ratio with a first scaling factor and a product of the second power ratio with a second scaling factor.

78. The method of claim 72, wherein a first power ratio between the set of reference signals and resource elements of a data channel is configured for the first symbol

period and a second power ratio between the set of reference signals and resource elements of the data channel is configured for the second symbol period.

79. The method of claim 78, wherein, for a first subset of values of a system information parameter, the power ratio corresponds to the first power ratio, and for a second subset of values of the system information parameter, the power ratio corresponds to the second power ratio.

80. The method of claim 78, wherein the power ratio is identified based on a table indexed by the number of antenna ports and a ratio of the first power ratio and the second power ratio.

81. The method of claim 72, wherein the identifying the power ratio is independent of a first power ratio between the set of reference signals and resource elements of a data channel for the first symbol period and a second power ratio between the set of reference signals and resource elements of the data channel for the second symbol period.

82. The method of claim 72, wherein the power ratio is based at least in part on a per port power ratio for each of the number of antenna ports.

83. The method of claim 72, further comprising:
performing channel estimation or a channel measurement using the signal based at least in part on the power ratio.

84. The method of claim 72, further comprising:
receiving a power boost parameter associated with the signal, the power boost parameter indicating a configurable increase of a transmit power for the signal; and
wherein the identifying the power ratio is based at least in part on the power boost parameter.

85. The method of claim 72, wherein each of the number of antenna ports is associated with a single radio frequency (RF) chain at a transmitter of the signal.

86. The method of claim 72, wherein the signal comprises a resynchronization signal that comprises a plurality of repetitions of a first sequence that is based at least in part on a cell identifier of a cell.

87. The method of claim 72, wherein the signal comprises a wake-up signal transmitted prior to an associated paging occasion for the UE.

88. A method for wireless communication at a base station, comprising:
mapping a signal to a first subset of resource elements of a time-frequency resource block and a set of reference signals to a second subset of the resource elements of the time-frequency resource block, wherein the first subset of resource elements comprise a subset of resource elements of a first symbol period of the time-frequency resource block, and each resource element of a second symbol period of the time-frequency resource block;
identifying a power ratio between each of the first subset of resource elements and the set of reference signals based at least in part on a number of antenna ports of the set of reference signals; and
transmitting the signal and the set of reference signals based at least in part on the power ratio.

89. The method of claim 88, wherein the identifying the power ratio comprises:
evaluating a function of a first power ratio between the set of reference signals and resource elements of a data channel for the first symbol period and a second power ratio between the set of reference signals and resource elements of the data channel for the second symbol period.

90. The method of claim 89, wherein the function comprises normalizing the second power ratio by the first power ratio.

91. The method of claim 89, wherein the function comprises a minimum of the first power ratio and the second power ratio.

92. The method of claim 89, wherein the function comprises a maximum of the first power ratio and the second power ratio.

93. The method of claim 89, wherein the function comprises a sum of a product of the first power ratio with a first scaling factor and a product of the second power ratio with a second scaling factor.

94. The method of claim 88, wherein a first power ratio between the set of reference signals and resource elements of a data channel is configured for the first symbol period and a second power ratio between the set of reference signals and resource elements of the data channel is configured for the second symbol period.

95. The method of claim 94, wherein, for a first subset of values of a system information parameter, the power ratio corresponds to the first power ratio, and for a second subset of values of the system information parameter, the power ratio corresponds to the second power ratio.

96. The method of claim 94, wherein the power ratio is identified based on a table indexed by the number of antenna ports and a ratio of the first power ratio and the second power ratio.

97. The method of claim 88, wherein the identifying the power ratio is independent of a first power ratio between the set of reference signals and resource elements of a data channel for the first symbol period and a second power ratio between the set of reference signals and resource elements of the data channel for the second symbol period.

98. The method of claim 88, wherein the power ratio is based at least in part on a per port power ratio for each of the number of antenna ports.

99. The method of claim 88, further comprising:
configuring a power boost parameter associated with the signal, the power boost parameter indicating a configurable increase of a transmit power for the signal, and wherein the identifying the power ratio is based at least in part on the power boost parameter.

100. The method of claim 99, wherein the power boost parameter is based at least in part on a number of blanked time-frequency resource blocks.

101. The method of claim 88, wherein a first reference signal of the set of reference signals is mapped to a first resource element of the time-frequency resource block and a second reference signal of the set of reference signals is mapped to a second resource element of the time-frequency resource block; and

the transmitting comprises transmitting, via a first antenna port, the first reference signal via the first resource element and a null symbol via the second resource element and transmitting, via a second antenna port, the second reference signal via the second resource element and a null symbol via the first resource element.

102. The method of claim 88, wherein each of the number of antenna ports is associated with a single radio frequency (RF) chain at the base station.

103. The method of claim 88, wherein the signal comprises a resynchronization signal that comprises a plurality of repetitions of a first sequence that is based at least in part on a cell identifier of a cell.

104. The method of claim 88, wherein the signal comprises a wake-up signal transmitted prior to a paging occasion.