

CLAIMS

What is claimed is:

- 1 1. A method of wireless communication comprising:
2 receiving a subframe comprising one or more beam reference signals and one
3 or more physical broadcast channel (PBCH) signals;
4 determining one or more channel estimates based at least in part on the one or
5 more beam reference signals; and
6 decoding one or more PBCH signals based at least in part on the one or more
7 channel estimates.
- 1 2. The method of claim 1, wherein the subframe is a synchronization
2 subframe comprising one or more synchronization signals.
- 1 3. The method of claim 2, wherein the one or more synchronization
2 signals comprise a primary synchronization signal, a secondary synchronization signal, an
3 extended synchronization signal, or any combination thereof.
- 1 4. The method of claim 1, wherein each of the one or more beam
2 reference signals comprise a set of signals corresponding to a set of antenna ports.
- 1 5. The method of claim 4, wherein the one or more PBCH signals
2 comprise a plurality of PBCH signals that are spatially multiplexed from each antenna port
3 across a same set of resource elements.
- 1 6. The method of claim 4, wherein the one or more beam reference
2 signals are code division multiplexed using a set of orthogonal cover codes over a set of
3 frequency tones, wherein each of the set of orthogonal cover codes is associated with an
4 antenna port of the set of antenna ports.
- 1 7. The method of claim 6, wherein the set of orthogonal cover codes is
2 based at least in part on a Hadamard matrix or a DFT matrix.
- 1 8. The method of claim 6, further comprising:
2 identifying a reference frequency tone of the set of frequency tones, wherein
3 the set of orthogonal cover codes comprises a weight value of one for each of the set of

4 antenna ports over the reference frequency tone, and wherein the one or more channel
5 estimates are based at least in part on identifying the reference frequency tone; and
6 identifying an additional reference frequency tone of the set of frequency
7 tones, wherein the set of orthogonal cover codes comprises a weight value of one for a first
8 half of the set of antenna ports and a weight value of negative one for a second half of the set
9 of antenna ports over the additional reference frequency tone, and wherein the one or more
10 channel estimates are based at least in part on identifying the additional reference frequency
11 tone.

1 9. The method of claim 8, wherein the reference frequency tone and the
2 additional reference frequency tone are middle tones of the set of frequency tones.

1 10. The method of claim 8, wherein a horizontal polarization, a vertical
2 polarization, or both for each of the set of antenna ports is associated with a transmission
3 direction.

1 11. The method of claim 4, wherein the set of antenna ports comprises a
2 set of antenna port pairs, and wherein each of the set of antenna port pairs is associated with a
3 transmission direction.

1 12. The method of claim 4, wherein the one or more beam reference
2 signals are frequency division multiplexed over a set of frequency tones.

1 13. The method of claim 1, wherein the one or more PBCH signals are pre-
2 coded using space frequency block coding.

1 14. The method of claim 1, wherein the one or more channel estimates
2 comprises a plurality of frequency specific channel estimates.

1 15. The method of claim 1, wherein the subframe is received using a
2 millimeter wave (mmW) band.

1 16. The method of claim 1, further comprising:
2 performing an access procedure for a wireless network based at least in part on
3 decoding the one or more PBCH signals.

1 17. A method of wireless communication comprising:
2 transmitting a subframe comprising one or more beam reference signals and
3 one or more physical broadcast channel (PBCH) signals, wherein the one or more beam

4 reference signals are configured to be used as a basis for one or more channel estimates for
5 decoding one or more PBCH signals.

1 18. The method of claim 17, wherein the subframe is a synchronization
2 subframe comprising one or more synchronization signals.

1 19. The method of claim 17, wherein each of the one or more beam
2 reference signals comprise a set of signals corresponding to a set of antenna ports.

1 20. The method of claim 19, wherein the one or more beam reference
2 signals are code division multiplexed using a set of orthogonal cover codes over a set of
3 frequency tones.

1 21. The method of claim 20, further comprising:
2 identifying a reference frequency tone of the set of frequency tones, wherein
3 the set of orthogonal cover codes comprise a weight value of one for each of the set of
4 antenna ports over the reference frequency tone, wherein the one or more channel estimates
5 are based at least in part on the reference frequency tone; and
6 identifying an additional reference frequency tone of the set of frequency
7 tones, wherein the set of orthogonal cover codes comprise a weight value of one for a first
8 half of the set of antenna ports and a weight value of negative one for a second half of the set
9 of antenna ports over the additional reference frequency tone, and wherein the one or more
10 channel estimates are based at least in part on the additional reference frequency tone.

1 22. The method of claim 21, wherein the reference frequency tone and the
2 additional reference frequency tone are middle tones of the set of frequency tones.

1 23. The method of claim 19, wherein the set of antenna ports comprises a
2 set of antenna port pairs, and wherein each of the set of antenna port pairs is associated with a
3 transmission direction.

1 24. The method of claim 17, wherein the one or more beam reference
2 signals are frequency division multiplexed over a set of frequency tones.

1 25. An apparatus for wireless communication comprising:
2 means for receiving a subframe comprising one or more beam reference
3 signals and one or more physical broadcast channel (PBCH) signals;
4 means for determining one or more channel estimates based at least in part on

5 the one or more beam reference signals; and

6 means for decoding one or more PBCH signals based at least in part on the
7 one or more channel estimates.

1 26. The apparatus of claim 25, wherein the subframe is a synchronization
2 subframe comprising one or more synchronization signals.

1 27. The apparatus of claim 26, wherein the one or more synchronization
2 signals comprise a primary synchronization signal, a secondary synchronization signal, an
3 extended synchronization signal, or any combination thereof.

1 28. The apparatus of claim 25, wherein each of the one or more beam
2 reference signals comprise a set of signals corresponding to a set of antenna ports.

1 29. The apparatus of claim 28, wherein the one or more PBCH signals
2 comprise a plurality of PBCH signals that are spatially multiplexed from each antenna port
3 across a same set of resource elements.

1 30. The apparatus of claim 28, wherein the one or more beam reference
2 signals are code division multiplexed using a set of orthogonal cover codes over a set of
3 frequency tones, wherein each of the set of orthogonal cover codes is associated with an
4 antenna port of the set of antenna ports.

1 31. The apparatus of claim 30, wherein the set of orthogonal cover codes is
2 based at least in part on a Hadamard matrix or a DFT matrix.

1 32. The apparatus of claim 30, further comprising:
2 means for identifying a reference frequency tone of the set of frequency tones,
3 wherein the set of orthogonal cover codes comprises a weight value of one for each of the set
4 of antenna ports over the reference frequency tone, and wherein the one or more channel
5 estimates are based at least in part on identifying the reference frequency tone; and

6 means for identifying an additional reference frequency tone of the set of
7 frequency tones, wherein the set of orthogonal cover codes comprises a weight value of one
8 for a first half of the set of antenna ports and a weight value of negative one for a second half
9 of the set of antenna ports over the additional reference frequency tone, and wherein the one
10 or more channel estimates are based at least in part on identifying the additional reference
11 frequency tone.

1 33. The apparatus of claim 32, wherein the reference frequency tone and
2 the additional reference frequency tone are middle tones of the set of frequency tones.

1 34. The apparatus of claim 25, wherein the one or more PBCH signals are
2 pre-coded using space frequency block coding.

1 35. An apparatus for wireless communication comprising:
2 means for transmitting a subframe comprising one or more beam reference
3 signals and one or more physical broadcast channel (PBCH) signals, wherein the one or more
4 beam reference signals are configured to be used as a basis for one or more channel estimates
5 for decoding one or more PBCH signals.

1 36. The apparatus of claim 35, wherein the subframe is a synchronization
2 subframe comprising one or more synchronization signals.

1 37. The apparatus of claim 35, wherein each of the one or more beam
2 reference signals comprise a set of signals corresponding to a set of antenna ports.

1 38. The apparatus of claim 37, wherein the one or more beam reference
2 signals are code division multiplexed using a set of orthogonal cover codes over a set of
3 frequency tones.

1 39. The apparatus of claim 38, further comprising:
2 means for identifying a reference frequency tone of the set of frequency tones,
3 wherein the set of orthogonal cover codes comprise a weight value of one for each of the set
4 of antenna ports over the reference frequency tone, wherein the one or more channel
5 estimates are based at least in part on the reference frequency tone; and
6 means for identifying an additional reference frequency tone of the set of
7 frequency tones, wherein the set of orthogonal cover codes comprise a weight value of one
8 for a first half of the set of antenna ports and a weight value of negative one for a second half
9 of the set of antenna ports over the additional reference frequency tone, and wherein the one
10 or more channel estimates are based at least in part on the additional reference frequency
11 tone.

1 40. The apparatus of claim 39, wherein the reference frequency tone and
2 the additional reference frequency tone are middle tones of the set of frequency tones.

1 41. An apparatus for wireless communication, comprising:
2 a processor;
3 memory in electronic communication with the processor; and
4 instructions stored in the memory and operable, when executed by the
5 processor, to cause the apparatus to:
6 receive a subframe comprising one or more beam reference signals and one or
7 more physical broadcast channel (PBCH) signals;
8 determine one or more channel estimates based at least in part on the one or
9 more beam reference signals; and
10 decode one or more PBCH signals based at least in part on the one or more
11 channel estimates.

1 42. The apparatus of claim 41, wherein the subframe is a synchronization
2 subframe comprising one or more synchronization signals.

1 43. The apparatus of claim 42, wherein the one or more synchronization
2 signals comprise a primary synchronization signal, a secondary synchronization signal, an
3 extended synchronization signal, or any combination thereof.

1 44. The apparatus of claim 41, wherein each of the one or more beam
2 reference signals comprise a set of signals corresponding to a set of antenna ports.

1 45. The apparatus of claim 44, wherein the one or more PBCH signals
2 comprise a plurality of PBCH signals that are spatially multiplexed from each antenna port
3 across a same set of resource elements.

1 46. The apparatus of claim 44, wherein the one or more beam reference
2 signals are code division multiplexed using a set of orthogonal cover codes over a set of
3 frequency tones, wherein each of the set of orthogonal cover codes is associated with an
4 antenna port of the set of antenna ports.

1 47. The apparatus of claim 46, wherein the set of orthogonal cover codes is
2 based at least in part on a Hadamard matrix or a DFT matrix.

1 48. The apparatus of claim 46, wherein the instructions are operable to
2 cause the processor to:

3 identify a reference frequency tone of the set of frequency tones, wherein the
4 set of orthogonal cover codes comprises a weight value of one for each of the set of antenna
5 ports over the reference frequency tone, and wherein the one or more channel estimates are
6 based at least in part on identifying the reference frequency tone; and

7 identify an additional reference frequency tone of the set of frequency tones,
8 wherein the set of orthogonal cover codes comprises a weight value of one for a first half of
9 the set of antenna ports and a weight value of negative one for a second half of the set of
10 antenna ports over the additional reference frequency tone, and wherein the one or more
11 channel estimates are based at least in part on identifying the additional reference frequency
12 tone.

1 49. The apparatus of claim 48, wherein the reference frequency tone and
2 the additional reference frequency tone are middle tones of the set of frequency tones.

1 50. The apparatus of claim 48, wherein a horizontal polarization, a vertical
2 polarization, or both for each of the set of antenna ports is associated with a transmission
3 direction.

1 51. The apparatus of claim 44, wherein the set of antenna ports comprises
2 a set of antenna port pairs, and wherein each of the set of antenna port pairs is associated with
3 a transmission direction.

1 52. The apparatus of claim 44, wherein the one or more beam reference
2 signals are frequency division multiplexed over a set of frequency tones.

1 53. The apparatus of claim 41, wherein the one or more PBCH signals are
2 pre-coded using space frequency block coding.

1 54. The apparatus of claim 41, wherein the one or more channel estimates
2 comprises a plurality of frequency specific channel estimates.

1 55. The apparatus of claim 41, wherein the subframe is received using a
2 millimeter wave (mmW) band.

1 56. The apparatus of claim 42, wherein the one or more synchronization
2 signals comprise a primary synchronization signal, a secondary synchronization signal, an
3 extended synchronization signal, or any combination thereof.

1 57. The apparatus of claim 41, wherein the instructions are operable to
2 cause the processor to:

3 perform an access procedure for a wireless network based at least in part on
4 decoding the one or more PBCH signals.

1 58. The apparatus of claim 41, wherein the one or more PBCH signals are
2 precoded for transmit diversity using space frequency block coding.

1 59. An apparatus for wireless communication, comprising:
2 a processor;
3 memory in electronic communication with the processor; and
4 instructions stored in the memory and operable, when executed by the
5 processor, to cause the apparatus to:
6 transmit a subframe comprising one or more beam reference signals and one
7 or more physical broadcast channel (PBCH) signals, wherein the one or more beam reference
8 signals are configured to be used as a basis for one or more channel estimates for decoding
9 one or more PBCH signals.

1 60. The apparatus of claim 59, wherein the subframe is a synchronization
2 subframe comprising one or more synchronization signals.

1 61. The apparatus of claim 59, wherein each of the one or more beam
2 reference signals comprise a set of signals corresponding to a set of antenna ports.

1 62. The apparatus of claim 61, wherein the one or more beam reference
2 signals are code division multiplexed using a set of orthogonal cover codes over a set of
3 frequency tones.

1 63. The apparatus of claim 62, wherein the instructions are operable to
2 cause the processor to:
3 identify a reference frequency tone of the set of frequency tones, wherein the
4 set of orthogonal cover codes comprise a weight value of one for each of the set of antenna
5 ports over the reference frequency tone, wherein the one or more channel estimates are based
6 at least in part on the reference frequency tone; and
7 identify an additional reference frequency tone of the set of frequency tones,
8 wherein the set of orthogonal cover codes comprise a weight value of one for a first half of
9 the set of antenna ports and a weight value of negative one for a second half of the set of

10 antenna ports over the additional reference frequency tone, and wherein the one or more
11 channel estimates are based at least in part on the additional reference frequency tone.

1 64. The apparatus of claim 63, wherein the reference frequency tone and
2 the additional reference frequency tone are middle tones of the set of frequency tones.

1 65. The apparatus of claim 61, wherein the set of antenna ports comprises
2 a set of antenna port pairs, and wherein each of the set of antenna port pairs is associated with
3 a transmission direction.

1 66. The apparatus of claim 59, wherein the one or more beam reference
2 signals are frequency division multiplexed over a set of frequency tones.

1 67. A non-transitory computer-readable medium storing code for wireless
2 communication, the code comprising instructions executable to:
3 receive a subframe comprising one or more beam reference signals and one or
4 more physical broadcast channel (PBCH) signals;
5 determine one or more channel estimates based at least in part on the one or
6 more beam reference signals; and
7 decode one or more PBCH signals based at least in part on the one or more
8 channel estimates.

1 68. A non-transitory computer-readable medium storing code for wireless
2 communication, the code comprising instructions executable to:
3 transmit a subframe comprising one or more beam reference signals and one
4 or more physical broadcast channel (PBCH) signals, wherein the one or more beam reference
5 signals are configured to be used as a basis for one or more channel estimates for decoding
6 one or more PBCH signals.