

CLAIMS

1. A method for wireless communications in a network, comprising:
 - determining a first bandwidth within a larger system bandwidth to transmit a first positioning reference signal (PRS) to a first type of user equipment (UE), wherein resource blocks (RBs) outside the first bandwidth are used for signals other than the first PRS;
 - determining a second bandwidth within the system bandwidth to transmit a second PRS to a second type of UE, wherein RBs outside of the second bandwidth are used for signals other than the second PRS; and
 - transmitting information associated with the first PRS and the second PRS.
2. The method of claim 1, wherein the first type of UE comprises a narrowband UE capable of narrowband communication with the network on a narrowband region of a larger system bandwidth, and wherein the first bandwidth comprises the narrowband region of the larger system bandwidth.
3. The method of claim 1, wherein the second type of UE comprises a wideband UE not capable of narrowband communication with the network.
4. The method of claim 1, further comprising determining a first periodicity for transmitting the first PRS and a second periodicity for transmitting the second PRS, and wherein the first periodicity for transmitting the first PRS is more frequent than the second periodicity for transmitting the second PRS.
5. The method of claim 1, wherein:
 - the information associated with the first PRS comprises information indicating the first bandwidth to receive the first PRS, a periodicity at which the first PRS is to be transmitted, a muting pattern for the first PRS, and a number of consecutive subframes for receiving the first PRS; and
 - the information associated with the second PRS comprises information indicating the second bandwidth to receive the second PRS, a periodicity at which the second PRS is to be

transmitted, a muting pattern for the second PRS, and a number of consecutive subframes for receiving the second PRS.

6. The method of claim 5, wherein the information further comprises an offset between the first bandwidth and the second bandwidth, and wherein transmitting comprises transmitting the information associated with the first PRS and the second PRS to the first type of UE and the second type of UE.

7. The method of claim 5, further comprising transmitting the information associated with the first PRS and the second PRS to the first type of UE, and transmitting the information associated with the second PRS to the second type of UE.

8. The method of claim 5, wherein the information indicates a bandwidth representing a minimum of the first PRS and the second PRS, and further comprising transmitting the information indicating a bandwidth representing a minimum of the first PRS and the second PRS to the first type of UE.

9. The method of claim 1, wherein the information comprises information indicating at least one of:

- a periodicity at which the first PRS and the second PRS is to be transmitted;
- a bandwidth to receive the first PRS, a muting pattern for the first PRS, and a number of consecutive subframes for receiving the first PRS; or
- a bandwidth to receive the second PRS, a muting pattern for the second PRS, and a number of consecutive subframes for receiving the second PRS.

10. The method of claim 1, further comprising using resource blocks outside of the first bandwidth and the second bandwidth to transmit at least one of unicast or broadcast channels.

11. The method of claim 1, wherein transmitting the information associated with the first PRS and the second PRS comprises:

- transmitting the information to the second type of UE, wherein the information comprises

information indicating the second bandwidth and a number of consecutive subframes for receiving the second PRS; and

transmitting the information to the first type of UE, wherein the information comprises a bitmask indicating narrowband subframes in which to receive the first PRS.

12. The method of claim 1, wherein the first bandwidth and the second bandwidth are centered around a center of the system bandwidth.

13. The method of claim 1, wherein:

at least one of the first bandwidth or the second bandwidth is not centered around a center of the system bandwidth; and

the information comprises information indicating a frequency offset for at least one of the first bandwidth or the second bandwidth, indicating how much the first bandwidth or the second bandwidth is shifted from the center of the system bandwidth.

14. The method of claim 1, wherein:

at least one of the first bandwidth or the second bandwidth is not centered around a center of the system bandwidth;

the information comprises a subband PRS muting indication, indicating where, in the first bandwidth or in the second bandwidth, PRS is muted; and

the subband PRS muting indication is unique to a base station.

15. An apparatus for wireless communications in a network, comprising:

at least one processor configured to:

determine a first bandwidth within a larger system bandwidth to transmit a first positioning reference signal (PRS) to a first type of user equipment (UE), wherein resource blocks (RBs) outside the first bandwidth are used for signals other than the first PRS;

determining a second bandwidth within the system bandwidth to transmit a second PRS to a second type of UE, wherein RBs outside of the second bandwidth are used for signals other than the second PRS;

a memory coupled with the at least one processor; and
a transmitter configured to transmit information associated with the first PRS and the second PRS.

16. The apparatus of claim 15, wherein the first type of UE comprises a narrowband UE capable of narrowband communication with the network on a narrowband region of a larger system bandwidth, and wherein the first bandwidth comprises the narrowband region of the larger system bandwidth.

17. The apparatus of claim 15, wherein the second type of UE comprises a wideband UE not capable of narrowband communication with the network.

18. The apparatus of claim 15, wherein the at least one processor is further configured to determine a first periodicity for transmitting the first PRS and a second periodicity for transmitting the second PRS, and wherein the first periodicity for transmitting the first PRS is more frequent than the second periodicity for transmitting the second PRS.

19. The apparatus of claim 15, wherein:

the information associated with the first PRS comprises information indicating the first bandwidth to receive the first PRS, a periodicity at which the first PRS is to be transmitted, a muting pattern for the first PRS, and a number of consecutive subframes for receiving the first PRS; and

the information associated with the second PRS comprises information indicating the second bandwidth to receive the second PRS, a periodicity at which the second PRS is to be transmitted, a muting pattern for the second PRS, and a number of consecutive subframes for receiving the second PRS.

20. The apparatus of claim 19, wherein the information further comprises an offset between the first bandwidth and the second bandwidth, and wherein the transmitter is further configured to transmit the information associated with the first PRS and the second PRS to the first type of UE and the second type of UE.

21. The apparatus of claim 19, wherein the transmitter is further configured to transmit the information associated with the first PRS and the second PRS to the first type of UE, and transmitting the information associated with the second PRS to the second type of UE.
22. The apparatus of claim 19, wherein the information indicates a bandwidth representing a minimum of the first PRS and the second PRS, and wherein the transmitter is further configured to transmit the information indicating a bandwidth representing a minimum of the first PRS and the second PRS to the first type of UE.
23. The apparatus of claim 15, wherein the information comprises information indicating at least one of:
 - a periodicity at which the first PRS and the second PRS is to be transmitted;
 - a bandwidth to receive the first PRS, a muting pattern for the first PRS, and a number of consecutive subframes for receiving the first PRS; or
 - a bandwidth to receive the second PRS, a muting pattern for the second PRS, and a number of consecutive subframes for receiving the second PRS.
24. The apparatus of claim 15, wherein the at least one processor is further configured to use resource blocks outside of the first bandwidth and the second bandwidth to transmit at least one of unicast or broadcast channels.
25. The apparatus of claim 15, wherein the transmitter is configured to transmit the information associated with the first PRS and the second PRS by:
 - transmitting the information to the second type of UE, wherein the information comprises information indicating the second bandwidth and a number of consecutive subframes for receiving the second PRS; and
 - transmitting the information to the first type of UE, wherein the information comprises a bitmask indicating narrowband subframes in which to receive the first PRS.
26. The apparatus of claim 15, wherein the first bandwidth and the second bandwidth are

centered around a center of the system bandwidth.

27. The apparatus of claim 15, wherein:

at least one of the first bandwidth or the second bandwidth is not centered around a center of the system bandwidth; and

the information comprises information indicating a frequency offset for at least one of the first bandwidth or the second bandwidth, indicating how much the first bandwidth or the second bandwidth is shifted from the center of the system bandwidth.

28. The apparatus of claim 15, wherein:

at least one of the first bandwidth or the second bandwidth is not centered around a center of the system bandwidth;

the information comprises a subband PRS muting indication, indicating where, in the first bandwidth or in the second bandwidth, PRS is muted; and

the subband PRS muting indication is unique a base station.

29. An apparatus for wireless communications in a network, comprising:

means for determining a first bandwidth within a larger system bandwidth to transmit a first positioning reference signal (PRS) to a first type of user equipment (UE), wherein resource blocks (RBs) outside the first bandwidth are used for signals other than the first PRS;

means for determining a second bandwidth within the system bandwidth to transmit a second PRS to a second type of UE, wherein RBs outside of the second bandwidth are used for signals other than the second PRS; and

means for transmitting information associated with the first PRS and the second PRS.

30. A non-transitory computer readable medium for wireless communications in a network, comprising:

instructions that, when executed by at least one processor, configure the at least one processor to:

determine a first bandwidth within a larger system bandwidth to transmit a first positioning reference signal (PRS) to a first type of user equipment (UE), wherein

resource blocks (RBs) outside the first bandwidth are used for signals other than the first PRS;

determine a second bandwidth within the system bandwidth to transmit a second PRS to a second type of UE, wherein RBs outside of the second bandwidth are used for signals other than the second PRS; and

transmit information associated with the first PRS and the second PRS.

31. A method for wireless communication in a network, comprising:
receiving configuration information, wherein the configuration information comprises:
for a first type of user equipment (UE), a first indication of a first bandwidth within a larger system bandwidth to receive a first positioning reference signal (PRS), wherein resource blocks (RBs) outside the first bandwidth are used for signals other than the first PRS; and
for a second type of UE, an indication of a second bandwidth within the system bandwidth to receive a second PRS, wherein RBs outside of the second bandwidth are used for signals other than the second PRS; and
receiving at least one of the first PRS or the second PRS based, at least in part, on the configuration information.
32. The method of claim 31, wherein the first type of UE comprises a narrowband UE capable of narrowband communication with the network on a narrowband region of a larger system bandwidth, and wherein the first bandwidth comprises the narrowband region of the larger system bandwidth.
33. The method of claim 31, wherein the second type of UE comprises a wideband UE not capable of narrowband communication with the network.
34. The method of claim 31, wherein the first PRS is transmitted at a first periodicity and the second PRS is transmitted at a second periodicity, and wherein the first periodicity for transmitting the first PRS is more frequent than the second periodicity for transmitting the second PRS.

35. The method of claim 31, wherein the configuration information further comprises at least one of:

a periodicity at which the first PRS is to be transmitted, a muting pattern for the first PRS, and a number of consecutive subframes for receiving the first PRS; or

a periodicity at which the second PRS is to be transmitted, a muting pattern for the second PRS, and a number of consecutive subframes for receiving the second PRS.

36. The method of claim 35, wherein the configuration information further comprises an offset between the first bandwidth and the second bandwidth.

37. An apparatus for wireless communication in a network, comprising:

at least one processor configured to:

receive configuration information, wherein the configuration information comprises:

for a first type of user equipment (UE), a first indication of a first bandwidth within a larger system bandwidth to receive a first positioning reference signal (PRS) wherein resource blocks (RBs) outside the first bandwidth are used for signals other than the first PRS; and

for a second type of UE, an indication of a second bandwidth within the system bandwidth to receive a second PRS, wherein RBs outside of the second bandwidth are used for signals other than the second PRS; and

receive at least one of the first PRS or the second PRS based, at least in part, on the configuration information.

38. A method for wireless communications in a network, comprising:

determining a first bandwidth within a larger system bandwidth to transmit a first positioning reference signal (PRS) to a first type of user equipment (UE);

determining a second bandwidth different from the first bandwidth, within the system bandwidth to transmit a second PRS to a second type of UE; and

transmitting information associated with the first PRS and the second PRS; and

transmitting the first PRS associated with the first bandwidth in a first subframe of a radio frame; and

transmitting the second PRS associated with the second bandwidth in a second subframe of the radio frame different from the first subframe.

39. The method of claim 38, wherein the first type of UE comprises a narrowband UE capable of narrowband communication with the network on a narrowband region of a larger system bandwidth, and wherein the first bandwidth comprises the narrowband region of the larger system bandwidth.

40. The method of claim 38, wherein the second type of UE comprises a wideband UE not capable of narrowband communication with the network.

41. The method of claim 38, further comprising determining a first periodicity for transmitting the first PRS and a second periodicity for transmitting the second PRS, and wherein the first periodicity for transmitting the first PRS is more frequent than the second periodicity for transmitting the second PRS.

42. The method of claim 38, wherein:

the information associated with the first PRS comprises information indicating the first bandwidth to receive the first PRS, a periodicity at which the first PRS is to be transmitted, a muting pattern for the first PRS, and a number of consecutive subframes for receiving the first PRS; and

the information associated with the second PRS comprises information indicating the second bandwidth to receive the second PRS, a periodicity at which the second PRS is to be transmitted, a muting pattern for the second PRS, and a number of consecutive subframes for receiving the second PRS.

43. The method of claim 42, wherein the information further comprises an offset between the first bandwidth and the second bandwidth, and wherein transmitting comprises transmitting the information associated with the first PRS and the second PRS to the first type of UE and the

second type of UE.

44. The method of claim 42, further comprising transmitting the information associated with the first PRS and the second PRS to the first type of UE, and transmitting the information associated with the second PRS to the second type of UE.

45. The method of claim 42, wherein the information indicates a bandwidth representing a minimum of the first PRS and the second PRS, and further comprising transmitting the information indicating a bandwidth representing a minimum of the first PRS and the second PRS to the first type of UE.

46. The method of claim 38, wherein the information comprises information indicating at least one of:

- a periodicity at which the first PRS and the second PRS is to be transmitted;
- a bandwidth to receive the first PRS, a muting pattern for the first PRS, and a number of consecutive subframes for receiving the first PRS; or
- a bandwidth to receive the second PRS, a muting pattern for the second PRS, and a number of consecutive subframes for receiving the second PRS.

47. The method of claim 38, further comprising using resource blocks outside of the first bandwidth and the second bandwidth to transmit at least one of unicast or broadcast channels.

48. The method of claim 38, wherein transmitting the information associated with the first PRS and the second PRS comprises:

- transmitting the information to the second type of UE, wherein the information comprises information indicating the second bandwidth and a number of consecutive subframes for receiving the second PRS; and

- transmitting the information to the first type of UE, wherein the information comprises a bitmask indicating narrowband subframes in which to receive the first PRS.

49. The method of claim 38, wherein the first bandwidth and the second bandwidth are

centered around a center of the system bandwidth.

50. The method of claim 38, wherein:

at least one of the first bandwidth or the second bandwidth is not centered around a center of the system bandwidth; and

the information comprises information indicating a frequency offset for at least one of the first bandwidth or the second bandwidth, indicating how much the first bandwidth or the second bandwidth is shifted from the center of the system bandwidth.

51. The method of claim 38, wherein:

at least one of the first bandwidth or the second bandwidth is not centered around a center of the system bandwidth;

the information comprises a subband PRS muting indication, indicating where, in the first bandwidth or in the second bandwidth, PRS is muted; and

the subband PRS muting indication is unique to a base station.

52. An apparatus for wireless communications in a network, comprising:

at least one processor configured to:

determine a first bandwidth within a larger system bandwidth to transmit a first positioning reference signal (PRS) to a first type of user equipment (UE);

determining a second bandwidth within the system bandwidth to transmit a second PRS to a second type of UE;

a memory coupled with the at least one processor; and

a transmitter configured to transmit:

information associated with the first PRS and the second PRS; and

the first PRS associated with the first bandwidth in a first subframe of a radio frame; and

the second PRS associated with the second bandwidth in a second subframe of the radio frame different from the first subframe.

53. The apparatus of claim 52, wherein the first type of UE comprises a narrowband UE

capable of narrowband communication with the network on a narrowband region of a larger system bandwidth, and wherein the first bandwidth comprises the narrowband region of the larger system bandwidth.

54. The apparatus of claim 52, wherein the second type of UE comprises a wideband UE not capable of narrowband communication with the network.

55. The apparatus of claim 52, wherein the at least one processor is further configured to determine a first periodicity for transmitting the first PRS and a second periodicity for transmitting the second PRS, and wherein the first periodicity for transmitting the first PRS is more frequent than the second periodicity for transmitting the second PRS.

56. The apparatus of claim 52, wherein:

the information associated with the first PRS comprises information indicating the first bandwidth to receive the first PRS, a periodicity at which the first PRS is to be transmitted, a muting pattern for the first PRS, and a number of consecutive subframes for receiving the first PRS; and

the information associated with the second PRS comprises information indicating the second bandwidth to receive the second PRS, a periodicity at which the second PRS is to be transmitted, a muting pattern for the second PRS, and a number of consecutive subframes for receiving the second PRS.

57. The apparatus of claim 56, wherein the information further comprises an offset between the first bandwidth and the second bandwidth, and wherein the transmitter is further configured to transmit the information associated with the first PRS and the second PRS to the first type of UE and the second type of UE.

58. The apparatus of claim 56, wherein the transmitter is further configured to transmit the information associated with the first PRS and the second PRS to the first type of UE, and transmitting the information associated with the second PRS to the second type of UE.

59. The apparatus of claim 56, wherein the information indicates a bandwidth representing a minimum of the first PRS and the second PRS, and wherein the transmitter is further configured to transmit the information indicating a bandwidth representing a minimum of the first PRS and the second PRS to the first type of UE.

60. The apparatus of claim 52, wherein the information comprises information indicating at least one of:

a periodicity at which the first PRS and the second PRS is to be transmitted;

a bandwidth to receive the first PRS, a muting pattern for the first PRS, and a number of consecutive subframes for receiving the first PRS; or

a bandwidth to receive the second PRS, a muting pattern for the second PRS, and a number of consecutive subframes for receiving the second PRS.

61. The apparatus of claim 52, wherein the at least one processor is further configured to use resource blocks outside of the first bandwidth and the second bandwidth to transmit at least one of unicast or broadcast channels.

62. The apparatus of claim 52, wherein the transmitter is configured to transmit the information associated with the first PRS and the second PRS by:

transmitting the information to the second type of UE, wherein the information comprises information indicating the second bandwidth and a number of consecutive subframes for receiving the second PRS; and

transmitting the information to the first type of UE, wherein the information comprises a bitmask indicating narrowband subframes in which to receive the first PRS.

63. The apparatus of claim 52, wherein the first bandwidth and the second bandwidth are centered around a center of the system bandwidth.

64. The apparatus of claim 52, wherein:

at least one of the first bandwidth or the second bandwidth is not centered around a center of the system bandwidth; and

the information comprises information indicating a frequency offset for at least one of the first bandwidth or the second bandwidth, indicating how much the first bandwidth or the second bandwidth is shifted from the center of the system bandwidth.

65. The apparatus of claim 52, wherein:

at least one of the first bandwidth or the second bandwidth is not centered around a center of the system bandwidth;

the information comprises a subband PRS muting indication, indicating where, in the first bandwidth or in the second bandwidth, PRS is muted; and

the subband PRS muting indication is unique a base station.

66. An apparatus for wireless communications in a network, comprising:

means for determining a first bandwidth within a larger system bandwidth to transmit a first positioning reference signal, PRS, to a first type of user equipment, UE;

means for determining a second bandwidth, different from the first bandwidth, within the system bandwidth to transmit a second PRS to a second type of UE;

means for transmitting information associated with the first PRS and the second PRS; and

means for transmitting the first PRS associated with the first bandwidth in a first subframe of a radio frame; and

means for transmitting the second PRS associated with the second bandwidth in a second subframe of the radio frame different from the first subframe.

67. A non-transitory computer readable medium for wireless communications in a network, comprising:

instructions that, when executed by at least one processor, configure the at least one processor to:

determine a first bandwidth within a larger system bandwidth to transmit a first positioning reference signal (PRS) to a first type of user equipment (UE);

determine a second bandwidth within the system bandwidth to transmit a second PRS to a second type of UE;

transmit information associated with the first PRS and the second PRS; and

transmit the first PRS associated with the first bandwidth in a first subframe of a radio frame; and

transmit the second PRS associated with the second bandwidth in a second subframe of the radio frame different from the first subframe.

68. A method for wireless communication in a network, comprising:
receiving information, wherein the information comprises at least one of:
for a first type of user equipment (UE), a first indication of a first bandwidth within a larger system bandwidth to receive a first positioning reference signal (PRS);
and
for a second type of UE, an indication of a second bandwidth, different from the first bandwidth, within the system bandwidth to receive a second PRS; and
receiving, based on the information, at least one of:
the first PRS associated with the first bandwidth in a first subframe of a radio frame; or
the second PRS associated with the second bandwidth in a second subframe of the radio frame.
69. The method of claim 68, wherein the first type of UE comprises a narrowband UE capable of narrowband communication with the network on a narrowband region of a larger system bandwidth, and wherein the first bandwidth comprises the narrowband region of the larger system bandwidth.
70. The method of claim 68, wherein the second type of UE comprises a wideband UE not capable of narrowband communication with the network.
71. The method of claim 68, wherein the first PRS is transmitted at a first periodicity and the second PRS is transmitted at a second periodicity, and wherein the first periodicity for transmitting the first PRS is more frequent than the second periodicity for transmitting the second PRS.

72. The method of claim 68, wherein the information further comprises at least one of:
a periodicity at which the first PRS is to be transmitted, a muting pattern for the first PRS, and a number of consecutive subframes for receiving the first PRS; or
a periodicity at which the second PRS is to be transmitted, a muting pattern for the second PRS, and a number of consecutive subframes for receiving the second PRS.
73. The method of claim 72, wherein the information further comprises an offset between the first bandwidth and the second bandwidth.
74. An apparatus for wireless communication in a network, comprising:
at least one processor configured to:
receive configuration information, wherein the configuration information comprises:
for a first type of user equipment (UE), a first indication of a first bandwidth within a larger system bandwidth to receive a first positioning reference signal (PRS); and
for a second type of UE, an indication of a second bandwidth, different from the first bandwidth, within the system bandwidth to receive a second PRS;
and
receive, based on the information, at least one of:
the first PRS associated with the first bandwidth in a first subframe of a radio frame; or
the second PRS associated with the second bandwidth in a second subframe of the radio frame; and
a memory coupled with the at least one processor.
75. The apparatus of claim 74, wherein:
the first type of UE comprises a narrowband UE capable of narrowband communication with the network on a narrowband region of a larger system bandwidth, and wherein the first bandwidth comprises the narrowband region of the larger system bandwidth; and
the second type of UE comprises a wideband UE not capable of narrowband

communication with the network.

76. The apparatus of claim 74, wherein the first PRS is transmitted at a first periodicity and the second PRS is transmitted at a second periodicity, and wherein the first periodicity for transmitting the first PRS is more frequent than the second periodicity for transmitting the second PRS.

77. The apparatus of claim 74, wherein the information further comprises at least one of:
an offset between the first bandwidth and the second bandwidth;
a periodicity at which the first PRS is to be transmitted, a muting pattern for the first PRS, and a number of consecutive subframes for receiving the first PRS; or
a periodicity at which the second PRS is to be transmitted, a muting pattern for the second PRS, and a number of consecutive subframes for receiving the second PRS.