CLAIMS

~~WHAT IS CLAIMED IS:~~

1. A method (700) for assisting a position determination of a user equipment ~~(~~, UE (120) communicating over a shared communication medium in unlicensed spectrum~~,~~ (344), comprising:

~~measuring,~~ Measuring (704), by the UE (120) at a first positioning reference signal ~~(~~, PRS~~)~~, measurement time during a first positioning occasion, a first PRS from a first evolved Node B ~~(~~, eNB~~)~~ (110B for a first secondary cell of a plurality of secondary cells, wherein the first eNB transmits the first PRS on the shared communication medium, and wherein the first PRS is configured according to a PRS configuration;

~~measuring,~~Measuring (706), by the UE (120) at a second PRS measurement time during a second positioning occasion, a second PRS from a second eNB (110C) for a second secondary cell of the plurality of secondary cells, wherein the second eNB transmits the second PRS on the shared communication medium, and wherein the second PRS is configured according to the PRS configuration; and

~~reporting,~~Reporting (708), by the UE~~,~~ (120), the measurement of the first PRS, the measurement of the second PRS, the first PRS measurement time, and the second PRS measurement time to a location server (170).
~~a location server.~~

2. The method ~~of claim 1, wherein the first eNB reports to the location server a first PRS transmission time at which the first eNB transmitted the first PRS, and wherein the second eNB reports to the location server a second PRS transmission time at which the second eNB transmitted the second PRS.~~

~~3. The method of claim 2, wherein:~~

~~the location server determines that the UE measured the first PRS from the first eNB and the second PRS from the second eNB based on the first PRS measurement time and the second PRS measurement time reported by the UE and the first PRS transmission time and the second PRS transmission time reported by the first and second eNBs, and~~

~~the location server determines the position of the UE based at least in part on the measurement of the first PRS and the measurement of the second PRS and a location of the first eNB and a location of the second eNB.~~

~~4. The method~~(700) of claim 1, further comprising:

~~receiving,~~Receiving (702), at the UE~~,~~ (120), positioning assistance data from the location server~~,~~ (170), the positioning assistance data including the PRS configuration~~.~~

~~5. The method of claim 4~~, wherein the positioning assistance data preferably indicates that the first eNB and the second eNB transmit PRS using different positioning occasions.

~~6~~3. The method ~~of claim 1, wherein:~~

~~the first eNB transmits the first PRS on the shared communication medium upon winning access to the shared communication medium, and~~

~~the second eNB transmits the second PRS on the shared communication medium upon winning access to the shared communication medium.~~

~~7. The method~~(700) of claim 1, wherein the measurement of the first PRS and the measurement of the second PRS are measurements of a reference signal time difference ~~(~~, RSTD~~)~~, for Observed Time Of Arrival ~~(~~, OTDOA~~)~~, positioning for Long Term Evolution ~~(~~, LTE~~)~~, wireless access.

~~8. The method of claim 1, further comprising:~~

~~measuring, by the UE at a third PRS measurement time during a third positioning occasion, a third PRS from a third eNB for a third secondary cell of the plurality of secondary cells, wherein the third eNB transmits the third PRS on the shared communication medium, and wherein the third PRS is configured according to the PRS configuration; and~~

~~reporting, by the UE, the measurement of the third PRS and the third PRS measurement time to the location server.~~

~~9. The method of claim 1, wherein the first eNB and the second eNB are the same eNB and the first secondary cell and the second secondary cell are different cells of the same eNB.~~

~~10~~4. A method (800) for determining a position of a user equipment ~~(~~, UE (120) communicating over a shared communication medium in unlicensed spectrum~~,~~ (344), comprising:

~~receiving,~~Receiving (806), at a location server (170) from a first evolved Node B ~~(~~, eNB (110B) for a first secondary cell of a plurality of secondary cells, a first positioning reference signal ~~(~~, PRS~~)~~, transmission time at which the first eNB transmitted a first PRS, wherein the first eNB (110B) transmits the first PRS on the shared communication medium according to a PRS configuration;

~~receiving,~~ Receiving (807), at the location server (170) from a second eNB (110C) for a second secondary cell of the plurality of secondary cells, a second PRS transmission time at which the second eNB transmitted a second PRS, wherein the second eNB transmits the second PRS on the shared communication medium according to the PRS configuration;

receiving~~,~~ (810), at the location server (170) from the UE~~,~~ (120), a first measurement of the first PRS, a second measurement of the second PRS, a first PRS measurement time at which the first measurement was taken, and a second PRS measurement time at which the second measurement was taken;

determining~~,~~ (812), by the location server~~,~~ (170), that the UE (120) measured the first PRS from the first eNB and the second PRS from the second eNB based on the first PRS measurement time, the second PRS measurement time, the first PRS transmission time, and the second PRS transmission time; and

determining~~,~~ (814), by the location server~~,~~ (170), the position of the UE (120) based at least in part on the first measurement, the second measurement, a location of the first eNB, and a location of the second eNB.

~~11~~5. The method (800) of claim ~~10~~4, further comprising:

~~receiving,~~ Receiving (802), by the location server~~,~~ (170), the PRS configuration from the first eNB~~,~~ (110B), the second eNB~~,~~ (110C), or from both eNBs.

~~12~~6. The method (800) of claim ~~10~~4, further comprising:

sending, by the location server~~,~~ (170), positioning assistance data to the UE~~,~~ (120), the positioning assistance data including the PRS configuration~~;~~

~~13. The method of claim 12~~, wherein preferably the positioning assistance data indicates that the first eNB (110B) and the second eNB (110C) transmit PRS using different positioning occasions.

~~14~~7. The method (800) of claim ~~10, wherein:~~

~~the first eNB transmits the first PRS on the shared communication medium upon winning access to the shared communication medium, and~~

~~the second eNB transmits the second PRS on the shared communication medium upon winning access to the shared communication medium.~~

~~15. The method of claim 10, further comprising:~~

~~receiving, at the location server from a third eNB for a third secondary cell for the plurality of secondary cells, a third PRS transmission time at which the third eNB transmitted a third PRS, wherein the third eNB transmits the third PRS on the shared communication medium according to the PRS configuration; and~~

~~receiving, at the location server from the UE, a third measurement of the third PRS and a third PRS measurement time at which the third measurement was taken.~~

~~16. The method of claim 15, further comprising:~~

~~receiving, by the location server, the PRS configuration from the third eNB.~~

~~17. The method of claim 15, further comprising:~~

~~determining, by the location server, that the UE measured the third PRS from the third eNB based on the third PRS transmission time and the third PRS measurement time; and~~

~~determining, by the location server, the position of the UE based at least in part on the third measurement and a location of the third eNB.~~

~~18. The method of claim 10~~4, wherein the measurement of the first PRS and the measurement of the second PRS are measurements of a reference signal time difference

(, RSTD), for Observed Time Of Arrival (, OTDOA), positioning for Long Term Evolution (, LTE), wireless access.

19. The method of claim 10, wherein the first eNB and the second eNB are the same eNB and the first secondary cell and the second secondary cell are different cells of the same eNB.

208. A method (900) for assisting a position determination of a user equipment (, UE 120) communicating over a shared communication medium in unlicensed spectrum, comprising:

transmitting, Transmitting (906), by an evolved Node B (, eNB (110B) for a secondary cell, a positioning reference signal (, PRS), on the shared communication medium at a positioning occasion according to a PRS configuration; and

sending, Sending (908), by the eNB to a location server, (170), a PRS transmission time at which the eNB transmitted the PRS.

219. The method (900) of claim 208, further comprising:

receiving, at least one of the following:

Receiving (902), at the eNB, (110B), the PRS configuration from the location server.,

22. The method of claim 20, further comprising:

sending, Sending (904), by the eNB, (110B), the PRS configuration to the location server., or

23. The method of claim 20, further comprising:

recording, by the eNB, (110B), the PRS transmission time at which the eNB (110B) transmitted the PRS.

2410. The method (900) of claim 208, wherein:

the eNB (110B) transmits the PRS on the shared communication medium upon winning access to the shared communication medium.,

25. The method of claim 24, wherein:

the eNB (110B) preferably performs a listen before talk procedure to win access to the shared communication medium before transmitting the PRS.

2611. The method (900) of claim 208, further comprising:

receiving a request from the location server (170) for the PRS transmission time at which the eNB transmitted the PRS; and

sending the PRS transmission time to the location server (170) in response to the request.

27. An apparatus12. A user equipment, UE (120), for assisting a position determination of a user equipment (UE (120) communicating over a shared communication medium in unlicensed spectrum, (344), comprising:

at least one processor of the UE configured to:

measuremeans for measuring, at a first positioning reference signal (, PRS), measurement time during a first positioning occasion, a first PRS from a first evolved NodeB (, eNB, (110B) for a first secondary cell of a plurality of secondary cells, wherein the first eNB transmits the first PRS on the shared communication medium, and wherein the first PRS is configured according to a PRS configuration;

measure, at a second PRS measurement time during a second positioning occasion, a second PRS from a second eNB for a second secondary cell of the plurality of secondary cells, wherein the second eNB transmits the second PRS on the shared communication medium, and wherein the second PRS is configured according to the PRS configuration; and

cause a transceiver of the UE to report the measurement of the first PRS, the measurement of the second PRS, the first PRS measurement time, and the second PRS measurement time to a location server.

28. The apparatus of claim 27, wherein the first eNB reports to the location server a first PRS transmission time at which the first eNB transmitted the first PRS, and wherein the second eNB reports to the location server a second PRS transmission time at which the second eNB transmitted the second PRS.

29. The apparatus of claim 28, wherein:

~~the location server determines that the UE measured the first PRS from the first eNB and the second PRS from the second eNB based on the first PRS measurement time and the second PRS measurement time reported by the UE and the first PRS transmission time and the second PRS transmission time reported by the first and second eNBs, and~~

~~the location server determines the position of the UE based at least in part on the measurement of the first PRS and the measurement of the second PRS and a location of the first eNB and a location of the second eNB.~~

~~30. The apparatus of claim 27, wherein the at least one processor is further configured to:~~

~~receive positioning assistance data from the location server, the positioning assistance data including the PRS configuration.~~

~~31. The apparatus of claim 30, wherein the positioning assistance data indicates that the first eNB and the second eNB transmit PRS using different positioning occasions.~~

~~32. The apparatus of claim 27, wherein:~~

~~the first eNB transmits the first PRS on the shared communication medium upon winning access to the shared communication medium, and~~

~~the second eNB transmits the second PRS on the shared communication medium upon winning access to the shared communication medium.~~

~~33. The apparatus of claim 27, wherein the measurement of the first PRS and the measurement of the second PRS are measurements of a reference signal time difference (RSTD) for Observed Time Of Arrival (OTDOA) positioning for Long Term Evolution (LTE) wireless access.~~

~~34. The apparatus of claim 27, wherein the at least one processor is further configured to:~~

~~measure, at a third PRS measurement time during a third positioning occasion, a third PRS from a third eNB for a third secondary cell of the plurality of secondary cells, wherein the third eNB transmits the third PRS on the shared communication medium, and wherein the third PRS is configured according to the PRS configuration; and~~

report the measurement of the third PRS and the third PRS measurement time to the location server.

35. The apparatus of claim 27, wherein the first eNB and the second eNB are the same eNB and the first secondary cell and the second secondary cell are different cells of the same eNB.

36. An apparatus for determining a position of a user equipment (UE) communicating over a shared communication medium in unlicensed spectrum, comprising:

a communication device of a location server configured to:

receive, from a first evolved Node B (eNB) for a first secondary cell of a plurality of secondary cells, a first positioning reference signal (PRS) transmission time at which the first eNB transmitted a first PRS, wherein the first eNB transmits the first PRS on the shared communication medium according to a PRS configuration;

receive, from a second eNB for a second secondary cell of the plurality of secondary cells, a second PRS transmission time at which the second eNB transmitted a second PRS, wherein the second eNB transmits the second PRS on the shared communication medium according to the PRS configuration; and

receive, from the UE, a first measurement of the first PRS, a second measurement of the second PRS, a first PRS measurement time at which the first measurement was taken, and a second PRS measurement time at which the second measurement was taken; and

at least one processor of the location server configured to:

determine that the UE measured the first PRS from the first eNB and the second PRS from the second eNB based on the first PRS measurement time and the second PRS measurement time received from the UE and the first PRS transmission time and the second PRS transmission time received from the first eNB and the second eNB; and

determine the position of the UE based at least in part on the first measurement, the second measurement, a location of the first eNB, and a location of the second eNB.

~~37. The apparatus of claim 36, wherein the communication device is further configured to:~~

~~receive the PRS configuration from the first eNB, the second eNB, or from both eNBs.~~

~~38. The apparatus of claim 36, wherein the communication device is further configured to:~~

~~send positioning assistance data to the UE, the positioning assistance data including the PRS configuration.~~

~~39. The apparatus of claim 38, wherein the positioning assistance data indicates that the first eNB and the second eNB transmit PRS using different positioning occasions.~~

~~40. The apparatus of claim 36, wherein:~~

~~the first eNB transmits the first PRS on the shared communication medium upon winning access to the shared communication medium, and~~

~~the second eNB transmits the second PRS on the shared communication medium upon winning access to the shared communication medium.~~

~~41. The apparatus of claim 36, wherein the communication device is further configured to:~~

~~receive, from a third eNB for a third secondary cell for the plurality of secondary cells, a third PRS transmission time at which the third eNB transmitted a third PRS, wherein the third eNB transmits the third PRS on the shared communication medium according to the PRS configuration; and~~

~~receive, from the UE, a third measurement of the third PRS and a third PRS measurement time at which the third measurement was taken.~~

~~42. The apparatus of claim 41, wherein the communication device is further configured to:~~

~~receive the PRS configuration from the third eNB.~~

~~43. The apparatus of claim 41, wherein the at least one processor is further configured to:~~

~~determine that the UE measured the third PRS from the third eNB based on the third PRS transmission time and the third PRS measurement time; and~~

~~determine the position of the UE based at least in part on the third measurement and a location of the third eNB.~~

~~44. The apparatus of claim 36, wherein the measurement of the first PRS and the measurement of the second PRS are measurements of a reference signal time difference (RSTD) for Observed Time Of Arrival (OTDOA) positioning for Long Term Evolution (LTE) wireless access.~~

~~45. The apparatus of claim 36, wherein the first eNB and the second eNB are the same eNB and the first secondary cell and the second secondary cell are different cells of the same eNB.~~

~~46. An apparatus for assisting a position determination of a user equipment (UE) communicating over a shared communication medium in unlicensed spectrum, comprising:~~

~~a transceiver of an evolved Node B (eNB) for a secondary cell configured to:~~

~~transmit a positioning reference signal (PRS) on the shared communication medium at a positioning occasion according to a PRS configuration; and~~

~~send, to a location server, a PRS transmission time at which the eNB transmitted the PRS.~~

~~47. The apparatus of claim 46, wherein the transceiver is further configured to:~~

~~receive the PRS configuration from the location server.~~

~~48. The apparatus of claim 46, wherein the transceiver is further configured to:~~

~~send the PRS configuration to the location server.~~

~~49. The apparatus of claim 46, further comprising:~~

~~at least one processor configured to record the PRS transmission time at which the eNB transmitted the PRS.~~

~~50. The apparatus of claim 46, wherein the eNB transmits the PRS on the shared communication medium upon winning access to the shared communication medium.~~

~~51. The apparatus of claim 50, wherein the eNB performs a listen before talk procedure to win access to the shared communication medium before transmission of the PRS.~~

~~52. The apparatus of claim 46, wherein the transceiver is further configured to:~~

~~receive a request from the location server for the PRS transmission time at which the eNB transmitted the PRS; and~~

~~send the PRS transmission time to the location server in response to the request.~~

~~53. A user equipment (UE) apparatus for assisting a position determination of a UE communicating over a shared communication medium in unlicensed spectrum, comprising:~~

~~means for measuring, at a first positioning reference signal (PRS) measurement time during a first positioning occasion, a first PRS from a first evolved NodeB (eNB) for a first secondary cell of a plurality of secondary cells, wherein the first eNB transmits the first PRS on the shared communication medium, and wherein the first PRS is configured according to a PRS configuration;~~

means for measuring, at a second PRS measurement time during a second positioning occasion, a second PRS from a second eNB (110C) for a second secondary cell of the plurality of secondary cells, wherein the second eNB transmits the second PRS on the shared communication medium, and wherein the second PRS is configured according to the PRS configuration; and

means for reporting the measurement of the first PRS, the measurement of the second PRS, the first PRS measurement time, and the second PRS measurement time to a location server~~.~~ (170).

~~54~~13. A location server ~~apparatus~~(170) for determining a position of a user equipment ~~(~~, UE (120) communicating over a shared communication medium in unlicensed spectrum~~,~~ (344), comprising:

means for receiving, from a first evolved Node B ~~(~~, eNB, (110B) for a first secondary cell of a plurality of secondary cells, a first positioning reference signal ~~(~~,

PRS~~)~~, transmission time at which the first eNB transmitted a first PRS, wherein the first eNB transmits the first PRS on the shared communication medium according to a PRS configuration;

means for receiving, from a second eNB (110C) for a second secondary cell of the plurality of secondary cells, a second PRS transmission time at which the second eNB transmitted a second PRS, wherein the second eNB transmits the second PRS on the shared communication medium according to the PRS configuration;

means for receiving, from the UE~~,~~ (120), a first measurement of the first PRS, a second measurement of the second PRS, a first PRS measurement time at which the first measurement was taken, and a second PRS measurement time at which the second measurement was taken;

means for determining that the UE (120) measured the first PRS from the first eNB and the second PRS from the second eNB (110B) based on the first PRS transmission time, the PRS transmission second time, the first PRS measurement time, and the second PRS measurement time; and

means for determining the position of the UE (120) based at least in part on the first measurement, the second measurement, a location of the first eNB~~,~~ (110B), and a location of the second eNB~~.~~ (110C).

~~55~~14. An evolved Node B ~~(~~, eNB~~) apparatus~~, (110B), for a secondary cell for assisting a position determination of a user equipment ~~(~~, UE~~)~~ (120), communicating over a shared communication medium in unlicensed spectrum~~,~~ (344), comprising:

~~means~~Means for transmitting a positioning reference signal ~~(~~, PRS~~)~~, on the shared communication medium at a positioning occasion according to a PRS configuration; and

means for sending, to a location server~~,~~ (170), a PRS transmission time at which the eNB (110B) transmitted the PRS.

~~56~~15. A non-transitory computer-readable medium storing computer-executable instructions for assisting a position determination of a user equipment ~~(~~, UE (120) communicating over a shared communication medium in unlicensed spectrum~~, the computer-executable instructions comprising:~~

~~at least one instruction instructing~~ which, when executed by the UE ~~to measure, at a first PRS measurement time during a first positioning occasion, a first positioning~~

~~reference signal (PRS) from a first evolved NodeB (eNB) for a first secondary cell of a plurality of secondary cells, wherein the first eNB transmits the first PRS on the shared communication medium, and wherein the first PRS is configured according to a PRS configuration;~~

~~at least one instruction instructing,~~ cause the UE to ~~measure, at a second PRS measurement time during a second positioning occasion, a second PRS from a second eNB for a second secondary cell of the plurality of secondary cells, wherein the second eNB transmits the second PRS on the shared communication medium, and wherein the second PRS is configured according to the PRS configuration; and~~

~~at least one instruction instructing the UE to report the measurement of the first PRS, the measurement of the second PRS, the first PRS measurement time, and the second PRS measurement time to a location server.~~

~~57. A non-transitory computer-readable medium storing~~carry out a method in accordance with the steps of any of claims 1 to 3, computer-executable instructions for determining a position of ~~a user equipment (UE) communicating over a shared communication medium in unlicensed spectrum, the computer-executable instructions comprising:~~

~~at least one instruction instructing a~~ said UE (120) which, when executed by a location server, cause the location server to ~~receive, from a first evolved Node B (eNB) for a first secondary cell of a plurality of secondary cells, a first PRS transmission time at which the first eNB transmitted a first positioning reference signal (PRS), wherein the first eNB transmits the first PRS on the shared communication medium according to a PRS configuration;~~

~~at least one instruction instructing the location server to receive, from a second eNB for a second secondary cell of the plurality of secondary cells, a second PRS transmission time at which the second eNB transmitted a second PRS, wherein the second eNB transmits the second PRS on the shared communication medium according to the PRS configuration;~~

~~at least one instruction instructing the location server to receive, from the UE, a first measurement of the first PRS, a second measurement of the second PRS, a first PRS measurement time at which the first measurement was taken, and a second PRS measurement time at which the second measurement was taken;~~

~~at least one instruction instructing the location server to determine that the UE measured the first PRS from the first eNB and the second PRS from the second eNB based on the first PRS transmission time, the second PRS transmission time, the first PRS measurement time, and the second PRS measurement time; and~~

~~at least one instruction instructing the location server to determine the position of the UE based at least~~carry out a method in ~~part on the first measurement, the second measurement, a location of the first eNB, and a location of the second eNB.~~

~~58. A non-transitory computer-readable medium storing~~accordance with the steps of any of claims 4 to 7, or computer-executable instructions for assisting a position determination of ~~a user equipment (UE) communicating over a shared communication medium~~the UE which, when executed by an eNodeB, cause the eNodeB to carry out a method in ~~unlicensed spectrum, the computer-executable instructions comprising:~~

~~at least one instruction instructing an evolved Node B (eNB) for a secondary cell to transmit a positioning reference signal (PRS) on the shared communication medium at a positioning occasion according to a PRS configuration; and~~

~~at least one instruction instructing the eNB to send, to a location server, a PRS transmission time at which the eNB transmitted the PRS.~~

accordance with the steps of any of claims 8-11.