Claims

1. An apparatus in a radio access network, the apparatus comprising at least one processor, and at least one memory storing instructions which, when executed by the at least one processor, cause the apparatus at least to:

select at least one user device from one or more candidate user devices as a reference for reference signal time difference (RSTD) measurement;

measure an RSTD between at least two reference signals, wherein the at least two reference signals comprise at least a sidelink positioning reference signal received from the at least one user device selected as the reference; and

transmit, to a network element of a core network, a report comprising: an identifier of the at least one user device selected as the reference for the RSTD measurement, an identifier of a resource associated with the sidelink positioning reference signal received from the at least one user device, synchronization source information indicating at least one synchronization source of the at least one user device, and a time stamp of the sidelink positioning reference signal received from the at least one user device.

2. The apparatus according to claim 1, further being caused to:

transmit, to the network element of the core network, a measurement report indicative of the measured RSTD associated with the at least one user device selected as the reference for the RSTD measurement.

3. The apparatus according to any preceding claim, wherein the at least two reference signals further comprise at least one of: a downlink positioning reference signal received from a network element of the radio access network, or a sidelink reference signal received from another user device.

4. The apparatus according to claim 3, wherein the report indicates that the reference is used for measuring the RSTD between the downlink positioning reference

signal and the sidelink positioning reference signal received from the at least one user device selected as the reference.

5. The apparatus according to any preceding claim, wherein the synchronization source information indicates at least one of: an access node, a cell identity, a physical cell identity, the physical cell identity and a synchronization signal block identity, the physical cell identity and a transmission and reception point identity, or a global navigation satellite system.

6. The apparatus according to any preceding claim, wherein the time stamp of the sidelink positioning reference signal received from the at least one user device indicates a reception time of the sidelink positioning reference signal at the apparatus.

7. The apparatus according to any preceding claim, wherein the report further comprises a location of the at least one user device at the time stamp, wherein the at least one user device is selected as the reference.

8. The apparatus according to any preceding claim, further being caused to:

receive, from the network element of the core network, an indication indicating one or more allowed synchronization sources for the reference,

wherein the one or more candidate user devices are synchronized to at least one of the one or more allowed synchronization sources.

9. The apparatus according to any preceding claim, further being caused to:

receive, from the network element of the core network, an indication indicating one or more synchronization sources that are not allowed for the reference,

wherein the one or more candidate user devices are not synchronized to the one or more synchronization sources that are not allowed.

10. The apparatus according to any preceding claim, further being caused to:

transmit, to the at least one user device or to the network element of the core network, one or more suggested time stamps for measuring a downlink positioning reference signal at the at least one user device or transmitting the sidelink positioning reference signal from the at least one user device.

11. The apparatus according to any preceding claim, further being caused to:

report, to the network element of the core network, an identifier of the one or more candidate user devices.

12. The apparatus according to any preceding claim, further being caused to:

receive, from the network element of the core network, an indication to use a single reference for measuring the RSTD,

wherein the at least one user device is selected based at least partly on the indication to use the single reference, the at least one user device comprising a single user device.

13. The apparatus according to any of claims 1-11, further being caused to:

receive, from the network element of the core network, an indication to use multiple references for measuring the RSTD,

wherein the at least one user device is selected based at least partly on the indication to use the multiple references.

14. An apparatus in a core network, the apparatus comprising at least one processor, and at least one memory storing instructions which, when executed by the at least one processor, cause the apparatus at least to:

receive, from a target user device, a report comprising: an identifier of at least one user device selected as a reference for measuring a reference signal time difference (RSTD), an identifier of a resource associated with a sidelink positioning reference signal used for measuring the RSTD, synchronization source information

indicating at least one synchronization source of the at least one user device selected as the reference for measuring the RSTD, and a time stamp of the sidelink positioning reference signal used for measuring the RSTD; and

estimate a location of the target user device based at least partly on the report.

15. The apparatus according to claim 14, further being caused to:

receive, from the target user device, a measurement report indicative of the measured RSTD associated with the at least one user device selected as the reference for measuring the RSTD measurement, wherein the location of the target user device is estimated based at least partly on the measured RSTD.

16. The apparatus according to any of claims 14-15, wherein the report indicates that the reference is used for measuring the RSTD between a downlink positioning reference signal and the sidelink positioning reference signal.

17. The apparatus according to any of claims 14-16, wherein the synchronization source information indicates at least one of: an access node, a cell identity, a physical cell identity, the physical cell identity and a synchronization signal block identity, the physical cell identity and a transmission and reception point identity, or a global navigation satellite system.

18. The apparatus according to any of claims 14-17, wherein the time stamp of the sidelink positioning reference signal indicates a reception time of the sidelink positioning reference signal at the target user device, or a transmission time of the sidelink positioning reference signal at the at least one user device.

19. The apparatus according to any of claims 14-18, wherein the report further comprises a location of the at least one user device at the time stamp, wherein the at least one user device is selected as the reference for measuring the RSTD.

20. The apparatus according to any of claims 14-19, further being caused to:

transmit, to the target user device, an indication indicating one or more allowed synchronization sources for the reference.

21. The apparatus according to any of claims 14-20, further being caused to:

transmit, to the target user device, an indication indicating one or more synchronization sources that are not allowed for the reference.

22. The apparatus according to any of claims 14-21, further being caused to:

receive, from the target user device, an identifier of one or more candidate user devices for the reference, wherein the one or more candidate user devices comprise at least the at least one user device.

23. The apparatus according to claim 22, further being caused to:

transmit, to the one or more candidates user devices, based on the identifier of the one or more candidate user devices, a threshold value for a time difference between receiving a downlink positioning reference signal and transmitting the sidelink positioning reference signal.

24. The apparatus according to any of claims 22-23, further being caused to:

receive, from the target user device, one or more suggested time stamps for measuring a downlink positioning reference signal at the one or more candidate user devices or transmitting the sidelink positioning reference signal from the one or more candidate user devices; and

transmit, to the one or more candidate user devices, a request for measuring the downlink positioning reference signal or transmitting the sidelink positioning reference signal at the one or more suggested time stamps.

25. The apparatus according to any of claims 22-24, further being caused to:

transmit, to the one or more candidate user devices, a request for reporting a location of the one or more candidate user devices and a corresponding time stamp; and

receive, from the one or more candidate user devices, based on the request, a report indicating the location of the one or more candidate user devices and the corresponding time stamp,

wherein the location of the target user device is estimated based at least partly on the location of the at least one user device comprised in the one or more candidate user devices.

26. The apparatus according to any of claims 14-25, further being caused to:

transmit, to the target user device, an indication to use a single reference for measuring the RSTD, wherein the at least one user device comprises a single user device.

27. The apparatus according to any of claims 14-25, further being caused to:

transmit, to the target user device, an indication to use multiple references for measuring the RSTD.