

SYSTEMS AND METHODS FOR INDICATING UPLINK INFORMATION

TECHNICAL FIELD

[0001] The disclosure relates generally to wireless communication, including but not limited to systems and methods for indicating uplink information.

BACKGROUND

[0002] The standardization organization Third Generation Partnership Project (3GPP) is currently in the process of specifying a new Radio Interface called 5G New Radio (5G NR) as well as a Next Generation Packet Core Network (NG-CN or NGC). The 5G NR will have three main components: a 5G Access Network (5G-AN), a 5G Core Network (5GC), and a User Equipment (UE). In order to facilitate the enablement of different data services and requirements, the elements of the 5GC, also called Network Functions (NFs), have been simplified with some of them being software based so that they could be adapted according to need.

SUMMARY

[0003] In one example, a wireless communication method includes receiving, by a wireless communication device from a network, a positioning request. The positioning request includes a request for at least one of performing an Uplink Time Difference of Arrival (UL-TDOA) positioning method, performing multi-Round-Trip Time (RTT) positioning method, performing Downlink Time Difference of Arrival (DL-TDOA) positioning method, performing Downlink Angle of Departure (DL-AoD) positioning method, performing Uplink Angle of Arrival (UL-AoA) positioning method, or reporting measurement information. The method includes reporting, by the wireless communication device to the network, the measurement information. The measurement information includes at least one of UL-TDOA measurement result, multi-RTT measurement result, DL-TDOA measurement result, DL-AoD measurement result, UL-AoA measurement result, Sounding Reference Signal (SRS) resource Identifier (ID), SRS resource set ID, UE Transmission (Tx) Timing Error Group (TEG) ID, association relationship between SRS

signaling and UE Tx TEGs, or Antenna Reference Point (ARP) information of SRS signaling. The SRS signaling includes at least one of the following: SRS resources, or SRS resource sets.

[0003A] In one aspect, the present disclosure refers to a wireless communication method, comprising, receiving, by a wireless communication device from a network, a positioning request, wherein the positioning request comprises reporting measurement information or a period of reporting measurement information, and reporting, by the wireless communication device to the network, the measurement information, wherein the measurement information comprises an association relationship between sounding reference signal (SRS) resources and User Equipment (UE) Transmission (Tx) Timing Error Groups (TEGs).

[0004] In some examples, the network includes a base station and a Location Management Function (LMF), the positioning request is configured by the base station, and the method further includes reporting, by the wireless communication device to the base station, the measurement information in at least one of a measurement report, an Uplink Control Information (UCI), a Channel State Information (CSI) feedback, or an PUCCH resource.

[0005] In some examples, the network includes a base station and a LMF, the positioning request is configured by the LMF. The method further includes reporting, by the wireless communication device to the LMF, the measurement information in at least one of an UL-TDOA report, a multi-RTT report, a DL-TDOA report.

[0006] In some examples, the LMF requests the base station to configure the positioning request.

[0007] In some examples, the positioning request includes a period of reporting measurement information.

[0008] In some examples, the method further includes in response to determining that the positioning request or the period of reporting measurement information is not received by the wireless communication device, determining, by the wireless communication

device, that the period of reporting the measurement information is same as a period of reporting configuration.

[0009] In some examples, the reporting configuration includes at least one of a measurement report, an UCI, a CSI feedback, a Physical Uplink Control Channel (PUCCH) resource, an UL-TDOA report, a multi-RTT report, a DL-TDOA report.

[0010] In some examples, the method further includes in response to determining that the positioning request or the period of reporting measurement information is not received by the wireless communication device, determining, by the wireless communication device, that the

period of reporting the measurement information is a subset of a period of reporting configuration.

[0011] In some examples, the reporting configuration includes at least one of a measurement report, an UCI, a CSI feedback, a PUCCH resource, an UL-TDOA report, a multi-RTT report, a DL-TDOA report.

[0012] In some examples, reporting the measurement information includes reporting the association relationship between the SRS signaling and the UE Tx TEGs using a bitmap.

[0013] In some examples, the association relationship between the SRS signaling and UE Tx TEGs in a first period of reporting the measurement information is same as the association relationship between the SRS signaling and UE Tx TEGs in a second period of reporting the measurement information. The SRS signaling are not transmitted in the first period of reporting the measurement information, and the SRS signaling are transmitted in the second period of reporting the measurement information. The second period of reporting the measurement information is a latest period before the first period of reporting the measurement information.

[0014] In some examples, UE Tx TEGs associated with the SRS signaling in a third period are default UE Tx TEGs, and the SRS signaling are not transmitted in the third period of reporting the measurement information.

[0015] In some examples, the measurement information further includes an indication. The indication indicates whether a transmit timing of a UE Reception-Transmission (Rx-Tx) time difference measurement is based on a transmit timing of an uplink subframe that is closest in time to a downlink subframe received from the network or a transmit timing of an uplink subframe in which one or more associated SRS signaling are transmitted.

[0016] In some examples, the multi-RTT measurement result includes at least one of one or more serving cell index of an associated SRS signaling, one or more SRS resource IDs,

one or more SRS resource set IDs, one or more UE Tx TEG IDs, one or more timestamps associated with the SRS resource ID, or one or more timing quality of the transmit timing.

[0017] In some examples, the DL-TDOA measurement result includes one timestamp per cell pair being applied to two Reference Signal Time Difference (RSTD) measurements associating with a same Positioning Reference Signal (PRS) resource.

[0018] In some examples, the DL-TDOA measurement result includes one or more RSTD measurements, a maximum number of the RSTD measurements for each pair of cell is greater than 4.

[0019] In some examples, an associated PRS resource ID or PRS resource set ID is not required to be reported, and the DL-TDOA measurement result, the multi-RTT measurement result or the DL-AoD measurement result includes ARP information corresponding to the associated PRS resource or associated PRS resource set.

[0020] Another example is a wireless communication apparatus including at least one processor and a memory, the at least one processor is configured to read code from the memory and implement a wireless communication method. The wireless communication method includes receiving, by a wireless communication device from a network, a positioning request. The positioning request includes a request for at least one of performing an UL-TDOA positioning method, performing multi-RTT positioning method, performing DL-TDOA positioning method, performing DL-AoD positioning method, performing UL-AoA positioning method, or reporting measurement information. The method includes reporting, by the wireless communication device to the network, the measurement information. The measurement information includes at least one of UL-TDOA measurement result, multi-RTT measurement result, DL-TDOA measurement result, DL-AoD measurement result, UL-AoA measurement result, SRS resource ID, SRS resource set ID, UE Tx TEG ID, association relationship between SRS signaling and UE Tx TEGs, or ARP information of SRS signaling. The SRS signaling includes at least one of the following: SRS resources, or SRS resource sets.

[0021] Another example is a computer program product including a computer-readable program medium code stored thereupon, the code, when executed by at least one processor, causing the at least one processor to implement a wireless communication method. The wireless communication method includes receiving, by a wireless communication device from a network, a positioning request. The positioning request includes a request for at least one of performing an UL-TDOA positioning method, performing multi-RTT positioning method, performing DL-TDOA positioning method, performing DL-AoD positioning method, performing UL-AoA positioning method, or reporting measurement information. The method includes reporting, by the wireless communication device to the network, the measurement information. The measurement information includes at least one of UL-TDOA measurement result, multi-RTT measurement result, DL-TDOA measurement result, DL-AoD measurement result, UL-AoA measurement result, SRS resource ID, SRS resource set ID, UE Tx TEG ID, association relationship between SRS signaling and UE Tx TEGs, or ARP information of SRS signaling. The SRS signaling includes at least one of the following: SRS resources, or SRS resource sets.

[0022] Another example is a wireless communication method including sending, by a network to a wireless communication device, a positioning request. The positioning request includes a request for at least one of performing an UL-TDOA positioning method, performing multi-RTT positioning method, performing DL-TDOA positioning method, performing DL-AoD positioning method, performing UL-AoA positioning method, or reporting measurement information. The method also includes receiving, by the network from the wireless communication device, the measurement information. The measurement information includes at least one of UL-TDOA measurement result, multi-RTT measurement result, DL-TDOA measurement result, DL-AoD measurement result, UL-AoA measurement result, SRS resource ID, SRS resource set ID, UE Tx TEG Identifier, association relationship between SRS signaling and UE Tx TEGs, or ARP information of SRS signaling. The SRS signaling includes at least one of the following: SRS resources, or SRS resource sets.

[0022A] In another aspect, the present disclosure refers to a wireless communication method, comprising, sending, by a network to a wireless communication device, a positioning request, wherein the positioning request comprises reporting measurement information or a period of reporting measurement information, and receiving, by the network from the wireless communication device, the measurement information, wherein the measurement information comprises an association relationship between sounding reference signal (SRS) resources and User Equipment (UE) Transmission (Tx) Timing Error Groups (TEGs).

[0023] In some examples, the network includes a base station and a LMF, the positioning request is configured by the base station. The method further includes receiving, by the base station from the wireless communication device, the measurement information in at least one of a measurement report, an UCI, a CSI feedback, or an PUCCH resource.

[0024] In some examples, the LMF requests the base station to configure the positioning request.

[0025] In some examples, the network includes a base station and a LMF, the positioning request is configured by the LMF. The method further includes receiving, by the LMF from the wireless communication device, the measurement information in at least one of an UL-TDOA report, a multi-RTT report, a DL-TDOA report.

[0026] In some examples, the network includes a base station and a LMF, sending, by the base station to the LMF, SRS coordinate information when a first condition satisfies. The SRS coordinate information includes at least one of a SRS coordinate, SRS ARP information, or SRS antenna panel information.

[0027] In some examples, the first condition includes at least one of: receiving beam information associated with positioning measurement is not reported by the base station; SRS signaling associated with the positioning measurement is Quasi Co-located (QCLed) with PRS resource or Synchronization Signal Block (SSB) resource, and the PRS resource or the SSB

resource is not configured with geographical coordinate; or receiving beam information associated with the positioning measurement is not reported by the base station, and SRS signaling associated with the positioning measurement is not configured with spatial relation information.

[0028] In some examples, the method further includes determining, by the network according to a UE capability report, that a transmit timing of a UE Rx-Tx time difference measurement is based on a transmit timing of an uplink subframe in which one or more associated SRS resources are transmitted.

[0029] In some examples, the UE capability report includes at least one of an indication that the wireless communication device supports TEG, or an indication that the wireless communication device supports determining the transmit timing of the UE Rx-Tx time difference measurement according to the transmit timing of the uplink subframe in which the one or more associated SRS resources are transmitted.

[0030] Another example is a wireless communication apparatus including at least one processor and a memory. The at least one processor is configured to read code from the memory and implement a wireless communication method. The wireless communication method includes sending, by a network to a wireless communication device, a positioning request. The positioning request includes a request for at least one of performing an UL-TDOA positioning method, performing multi-RTT positioning method, performing DL-TDOA positioning method, performing DL-AoD positioning method, performing UL-AoA positioning method, or reporting measurement information. The method also includes receiving, by the network from the wireless communication device, the measurement information. The measurement information includes at least one of UL-TDOA measurement result, multi-RTT measurement result, DL-TDOA measurement result, DL-AoD measurement result, UL-AoA measurement result, SRS resource ID, SRS resource set ID, UE Tx TEG Identifier, association relationship between SRS signaling and UE Tx TEGs, or ARP information of SRS signaling. The SRS signaling includes at least one of the following: SRS resources, or SRS resource sets.

[0030A] In yet another aspect, the present disclosure refers to a wireless communication device, comprising, at least one processor configured to receive, via a transceiver from a network, a positioning request, wherein the positioning request comprises reporting measurement information or a period of reporting measurement information, and report, via the transceiver to the network, the measurement information, wherein the measurement information comprises an association relationship between sounding reference signal (SRS) resources and User Equipment (UE) Transmission (Tx) Timing Error Groups (TEGs).

[0030B] In yet another aspect, the present disclosure refers to a network node, comprising, at least one processor configured to, send, via a transceiver to a wireless communication device, a positioning request, wherein the positioning request comprises reporting measurement information or a period of reporting measurement information, and receive, via the transceiver from the wireless communication device, the measurement information, wherein the measurement information comprises an association relationship between sounding reference signal (SRS) resources and User Equipment (UE) Transmission (Tx) Timing Error Groups (TEGs).

[0031] Another example is a computer program product including a computer-readable program medium code stored thereupon, the code, when executed by at least one processor, causing the at least one processor to implement a wireless communication method. The wireless communication method includes sending, by a network to a wireless communication device, a positioning request. The positioning request includes a request for at least one of performing an UL-TDOA positioning method, performing multi-RTT positioning method, performing DL-TDOA positioning method, performing DL-AoD positioning method, performing UL-AoA positioning method, or reporting measurement information. The method also includes receiving,