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Views on NR positioning for Rel-19

NTT DOCOMO, INC.

Background

- In NR, RAT-dependent positioning was specified for the first time in Rel-16.
  - Rel-16 NR supports Cell ID-based positioning, timing-based positioning and angle-based positioning.
    - » E.g., E-CID, DL-TDOA, UL-TDOA, Multi-RTT, DL-AoD, UL-AoA

- Rel-17 and Rel-18 introduced features to improve positioning performance and extend the covered use cases.
  - Improve positioning accuracy
    - » Rel-17: Rx/Tx timing error mitigation, improving UL-AoA/DL-AoD accuracy, multipath mitigation
    - » Rel-18: Carrier phase pos, BW aggregation
  - Improve positioning latency
    - » Rel-17: enh. of MG-based pos, MG-less pos
  - Expand device type for positioning
    - » Rel-18: SL pos, optimization for RedCap UE

Motivation

- There are leftover items from Rel-17 and Rel-18 discussion due to the huge workload.

- To complete NR positioning, Rel-19 should handle specific leftover items to cover each three key direction.
  - Provide higher positioning accuracy based on DL-AoD
    - » Rel-18 NR carrier phase positioning is based on timing measurements (e.g., RSTD) to resolve integer ambiguity. Significantly wide bandwidth may be required compared to angle-based methods (e.g., DL-AoD).
    - » The existing DL-AoD is based on RSRP/RSRPP measurements. On the other hand, DL-AoD based on carrier phase measurements would be expected to provide higher accuracy positioning without wide bandwidth. Especially, it may be beneficial for RedCap UEs.
  - Avoid degradation of positioning latency due to collision with other signal
    - » The existing DL-PRS Rx priority is lower than other DL signals except for PPW in RRC_CONNECTED.
    - » To avoid decreasing measurement occasion of DL-PRS, additional priority rule enabling high priority DL-PRS Rx would be beneficial.
  - Improve NW efficiency
    - » The existing DL positioning requires to use DL-PRS.
    - » To improve NW resource efficiency, reusing other DL RS (e.g., SSB, TRS) for positioning purpose would be beneficial.

Potential enhancements

- The following items can be considered as potential enhancements.
  - Provide higher positioning accuracy based on DL-AoD
    - » Specify angle-based positioning based on carrier phase measurements
      - – E.g., carrier phase-based DL-AoD
  - Avoid degradation of positioning latency due to collision with other signal
    - » Specify enhancements on DL-PRS Rx priority rule
      - – E.g., PPW support in RRC_INACTIVE
  - Improve NW efficiency
    - » Specify solution for NW efficiency
      - – E.g., Reusing SSB/TRS for positioning purpose

[Appendix]

- Provide higher positioning accuracy based on DL-AoD
  - Rel-18 NR carrier phase positioning:
    - » RSTD, RTOA and UE/gNB Rx-Tx time difference can be used for integer ambiguity resolution. In general, timing-based measurement accuracy depends on the size of bandwidth.
  - Rel-18 DL-AoD:
    - » The angle calculation is based on RSRP/RSRPP, and the strongest beam is expressed in DL-PRS resource ID. If carrier phase-based DL-AoD is supported, the strongest beam would be expressed in degree.
- Avoid degradation of positioning latency due to collision with other signal
  - Rel-18 DL-PRS Rx priority:
    - » Lowest priority for MG-based positioning
    - » Configurable within PPW (i.e., for MG-less positioning). PPW is supported in RRC_CONNECTED only.
- Improve NW efficiency
  - Rel-18 DL positioning:
    - » DL-PRS is required to operate DL-TDOA/DL-AoD/Multi-RTT. SSB and CSI-RS can be used for DL E-CID only.
  - Rel-18 UL positioning:
    - » SRS for positioning is required to operate UL-TDOA/UL-AoA/Multi-RTT. SRS for MIMO can be used for UL-TDOA/UL-AoA.

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