China Academy of Telecommunication Technology

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Further enhancements of NR positioning in Rel-19

CATT

2023-03-20

Outline

- Carrier Phase Positioning Enhancements
- Sidelink Positioning Enhancements
- XR Positioning
- Integrated NR positioning and data communication

NR Carrier Phase Positioning Enhancements

Motivation

- ✓ Rel-16 DL-PRS/SRS-Pos with staggered pattern and non-consecutive transmission in time domain are reused in Rel-18 CPP. This creates difficulties in tracking the carrier phase and maintaining the phase continuity, which is essential for certain applications.
- ✓ There is a strong demand for supporting high-accuracy positioning with narrow PRS/SRS bandwidth (e.g., 5MHz/20MHz), especially for Sidelink positioning and/or RedCap UE positioning.
- ✓ Rel-18 WI scope only covers carrier phase measurements for a single PFL/carrier.
- ✓ Some advanced CPP approaches, such as integer ambiguity resolution, differential corrections, are not supported in Rel-18.

Objectives

- ✓ Investigate the new positioning reference signals, methods, measurements, signalling, and procedures for enhancing NR DL/UL carrier phase positioning for UE-assisted, UE-based, and NG-RAN node assisted positioning, which including:
  - Developing new positioning reference signal, focusing on keeping phase continuity and improving positioning accuracy for carrier phase measurement
  - Exploring the use of the carrier phase measurements from multiple DL PFLs/UL carriers for NR CPP
  - Identifying potential resolutions of integer ambiguity in NR CPP under various scenarios (e.g., multiple PFLs/SRS carriers)
  - Enhancing NR CPP with narrow PRS bandwidth, e.g., supporting SL positioning and/or RedCap UE positioning
  - Investigating methods for mitigating multipath effects in NR CPP
  - Exploring more advanced differential techniques, such as differential corrections for precise point positioning (PPP) to further enhance the accuracy of NR CPP

SL Sidelink Positioning Enhancements

Motivation

- ✓ In Rel-18, only the sidelink positioning accuracy requirements of Set A (meter-level) can be satisfied in some use cases, but the sidelink positioning accuracy requirements of Set B (submeter-level) cannot be satisfied in most of use cases. There is significant demand on the Set B in a lot of application scenarios, e.g., V2X use cases and commercial use cases.
- ✓ Rel-18 NR sidelink positioning is designed based on the assumption of "always-on" operation. For Rel-19, sidelink positioning solutions for minimizing power consumption are required for vulnerable road users (VRUs) in V2X use cases and for UEs in public safety and commercial use cases.
- ✓ In high speed scenarios, the sidelink positioning accuracy will degrade significantly and cannot meet the requirements. It is urgent to study how to support the high accuracy sidelink positioning in the high-speed scenarios, e.g., up to 250Km/h for V2X highway use cases. At least the requirement Set A should be satisfied for UEs with speed of 250Km/h.

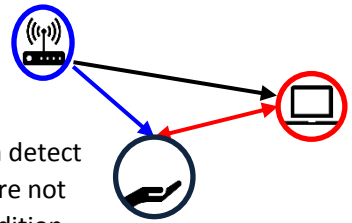
Objectives

- ✓ Study methods, measurements, signalling, and procedures for improving positioning accuracy of the Rel-18 NR positioning methods by enhancing sidelink positioning, including
  - Sidelink positioning method enhancements (incl., SL-CPP/ SL-AoD)
  - Tx/Rx timing error mitigation for sidelink positioning
  - Introduction of beam management for SL-PRS
  - Carrier aggregation for SL-PRS
  - SL-PRS transmission on unlicensed spectrum
  - UE speed/attitude measurement
  - Reduction of UE power consumption for sidelink positioning
  - Introduction of Rel-17 partial sensing to Rel-18 NR SL-PRS resource allocation mode 2
  - Sidelink positioning for UE in PC5 RRC_INACTIVE state
  - Improve the positioning accuracy in high-speed scenarios (Up to 250Km/h) to avoid the impact of doppler frequency shift

XR Positioning

Use case approved in SA1

- ✓ **Gesture Recognition for Application Navigation and Immersive Interaction,** for touchless control and immersive (i.e. XR) application.
- ✓ **NR-based RF sensing** Certain RF signals can detect small body movements and the RF signals are not susceptible to the ambient illumination condition and occlusions in the environment

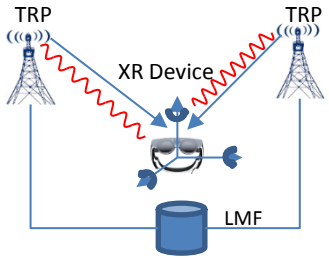


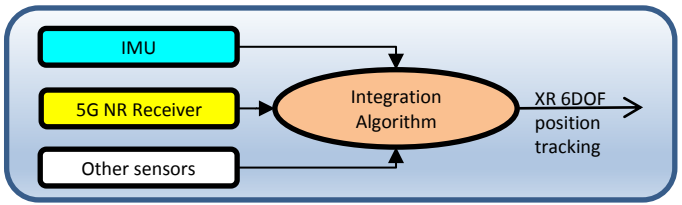
Performance requirements

- ✓ **XR positioning requires:**
  - Very high accuracy: < 1cm
  - Very low latency: < 20ms
  - 6DOF information: 3D coordinate and 3D orientation
  - High refreshing rate [s]
  - Low Missed detection [%]
  - Stable False alarm [%]

Potential work in Rel-19

- ✓ **NR carrier phase measurements combined with the measurements from IMU**, installed in smart phones, to support 6DOF XR positioning
- ✓ Study the potential benefits of supporting XR 6DOF position tracking in terms of position tracking accuracy, latency and reliability **based on NR positioning signals**





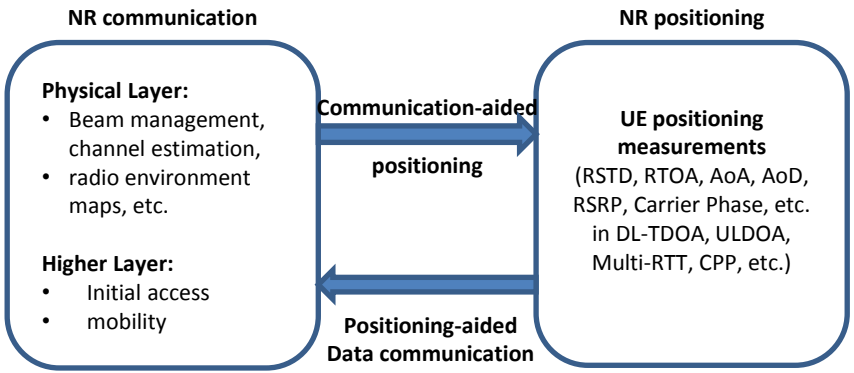
- ✓ The enhancement IMU measurements for supporting integrated NR/IMU positioning for XR positioning

Hand Tracking in XR applications requires 6DOF information with higher performance

Integrated NR Positioning & Communication

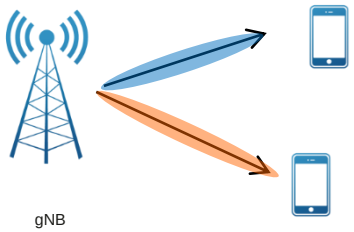
Motivations

- ✓ NR positioning and data communication are **traditionally developed separately in 3GPP**
- ✓ Intelligent integration of NR data communication and NR positioning may bring significant benefits of **improving the accuracy, latency, UE/gNB efficiency**, etc. for positioning
- ✓ increasing the **reliability**, **spectrum efficiency**, reducing **power consumption,** etc. for data communication



Potential Benefits

- ✓ Positioning-aided communication:
  - Reducing the overhead for Tx/Rx beam alignment
  - Obtaining related channel information
  - Enhancing initial access and mobility management
  - Optimizing radio resources management through a combination of UE channel information and position
- ✓ Positioning-aided communication:
  - Enhancing UE position accuracy with beam information, estimated channel state information
- ✓ Resource sharing of NR positioning and data communication



Study the benefits of integrated NR positioning and data communication

THANK YOU