3GPP TSG RAN Meeting #93-e

September 13th-17th, 2021

RP-212335

Rel-18 NR Positioning

Agenda Item: 9.0.2

Source: Intel Corporation

Document for: Discussion

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NR Positioning in R16/17

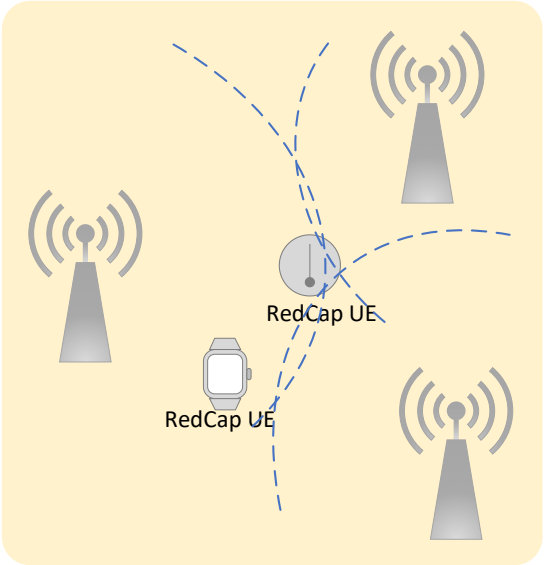
Use Cases, KPIs and Technology

- R16 Commercial KPIs
  - < 3m for 80% of UEs in indoor (both horizontal/vertical)
  - < 10m for 80% of UEs in outdoor (horizontal) and 3m for 80% of UEs in outdoor (vertical)
  - < 1s end to end latency
- R17 - Industrial-IoT KPIs
  - < 0.2m for 90% of UEs (horizontal)
  - < 1 m for 90% of UEs (vertical)
  - < 100ms, (~10 ms is desired) end-to-end latency
- NR Positioning Methods in R16/17
  - L1 structure for DL PRS and positioning SRS
  - DL positioning methods
    - ✓ DL-TDOA/DL-AoD with UE PRS RSTD/RSRP measurement report
  - UL positioning methods
    - ✓ UL-TDOA/UL-AoA with gNB RTOA / AoA(ZoA) measurement report
  - DL + UL positioning methods
    - ✓ Multi-RTT with gNB/UE Rx-Tx time difference measurement report
  - Latency reduction solutions

NR Positioning in R18+

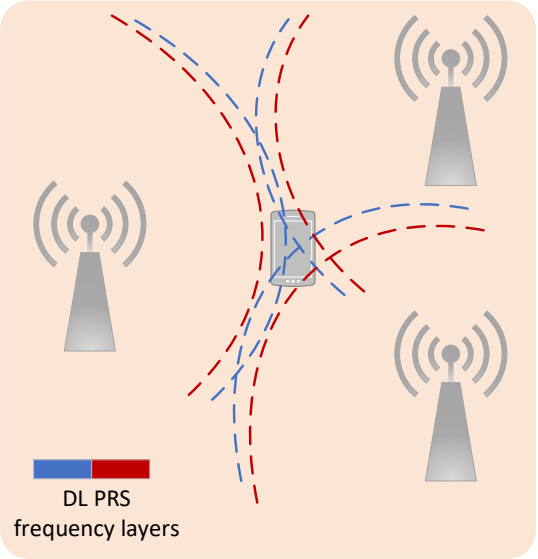
Potential Uu Enhancements

- R17 potential leftovers, if any
  - Phase measurements per channel path (1st arrival and additional paths)
- R18 potential topics
  - Positioning in unlicensed spectrum
  - Integrity of RAT-dependent solutions
  - Aggregation of DL/UL reference signals
  - NR positioning for RedCap UEs
  - Machine learning for NR positioning
  - Carrier phase-based positioning



Positioning of RedCap UEs

Aggregation of DL PRS frequency layers



NR Positioning

Observations on potential Uu enhancements

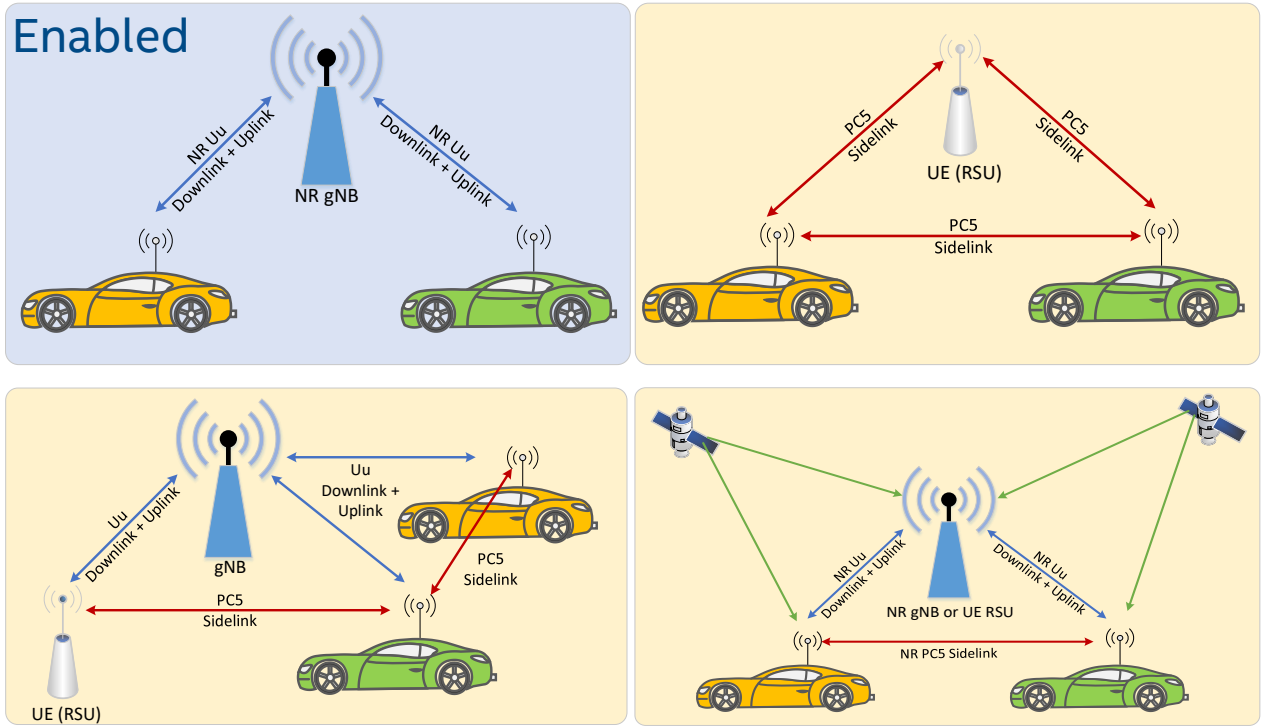
- Release 18
  - Unlicensed: NR positioning support in unlicensed spectrum is not defined so far
  - Aggregation: Objective was down-scoped from R17 WID / Beneficial for accuracy
  - Integrity: Objective for RAT-dependent solutions was down-scoped from R17
  - RedCap UEs: Optimization for UEs with reduced BW. Basic functionality is supported
  - Machine Learning : 1) Reconsideration of existing framework; 2) Many aspects can be left up to implementation; 3) Careful analysis requires revision of channel modelling (not a priority for R18)
  - Carrier phase-based positioning: Feasibility was not concluded / down-scoped from R16/R17

NR Positioning in R18+

Integration of Sidelink Positioning Methods

- Motivation
  - Driven by V2X / public safety (PS)
    - ✓ Applicable to other scenarios
  - V2X KPIs
    - ✓ Set 1: 10–50m w/ confidence 68–95%
    - ✓ Set 2: 1–3m w/ confidence 95–99%
    - ✓ Set 3: 0.1–0.5m w/ confidence 95–99%
    - ✓ 10 ms – 1 s positioning service latency
  - PS KPIs
    - ✓ H: 1 m, V: 2 m (absolute) or 0.3 m (relative), 95 – 98 % service availability

- Scenarios of interest



NR Positioning in R18+

Observation on sidelink positioning

- Sidelink positioning is demanded by vertical segments (V2X/PS, etc.)
- NR positioning in R17 is defined for Uu-based RAT-dependent solution (sidelink is not supported)
- Integration of sidelink can further improve NR positioning for RAT-dependent solutions
  - Uu positioning methods can be augmented by sidelink (PC5 positioning)
- Support of sidelink is beneficial for NR positioning in multiple scenarios (including out of coverage scenario)

NR Positioning in R18+

Spectrum Considerations

- ITS spectrum
  - DL/UL: Not applicable for DL/UL positioning in ITS
  - Sidelink: Lack of spectrum in low frequency band may limit precise positioning of sidelink solutions
- Licensed spectrum
  - DL/UL: NR positioning framework is already defined
  - Sidelink: Spectrum is owned by operators and may not be enabled for sidelink due to impact on Uu-interface
- Unlicensed spectrum
  - Applicable for DL/UL and SL
  - Large portion of spectrum is available in low frequency bands which is beneficial for NR positioning in general
- Observation
  - Unlicensed spectrum can be considered as a strong candidate for DL/UL/SL positioning to meet requirements

NR Positioning work in R18

Priorities for R18 work (listed in priority order)

- Integration of sidelink-aided positioning to NR RAT-dependent solutions
  - Specify reference signals, measurements, procedures/protocols
- Support of NR positioning in unlicensed spectrum for both Uu and PC5
- Integrity of RAT-dependent solutions for both Uu and PC5
- Aggregation of reference signals
- Positioning support for RedCap UEs
- Machine learning for positioning (study only)

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