RWS-210245

3GPP TSG RAN RAN Rel-18 workshop

Electronic Meeting, June 28 - July 2, 2021

Agenda Item: 4.3

# Enhancement for positioning

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# Background and proposed scope

## ❑ Background

- Acquiring accurate UE positioning is an essential requirement in many applications but NR positioning solutions defined so far do not fully cover all the use cases. Especially for V2X and public safety use cases, it is necessary to have positioning solutions that can operate regardless of the network coverage.

  ✓ RAN is conducing a study item "Study on scenarios and requirements of in-coverage, partial coverage, and out-of-coverage NR positioning use cases." Both absolute and relative UE positioning are being considered in the study.

- Since some specific use cases such as V2X were not much considered in the positioning items so far, there is a room to further enhance NR positioning solutions, in particular in consideration of the scenarios of such use cases.

  ✓ UE antenna is an example as V2X use cases include various different UE antenna configurations.

## ❑ Proposed Scope for NR sidelink enhancements in Rel-18

- Support of sidelink based positioning
- Support of sidelink assisted positioning
- Enhancements for UEs equipped with distributed antenna system

# Support of sidelink based positioning

## ❑ Motivation

- Sidelink "based" positioning refers to the positioning solutions that use sidelink as the radio link.
  - ✓ Positioning reference signals are transmitted in sidelink and the measurement of these signals are used to estimate the UE position.
  - ✓ For absolute positioning, some UEs are deployed in fixed locations and serve the role of anchor nodes. A moving UE transmits and/or receives sidelink PRS (S-PRS) to/from these fixed UEs, and the absolute position of the UE is derived from the S-PRS measurement and the location of the fixed UEs.
  - ✓ For relative positioning, a UE transmits and/or receives S-PRS to/from another UE at an unknown location. The distance and/or angle to the UE can be estimated after this procedure.

Figures from 5GAA TR "System Architecture and Solution Development; High-Accuracy Positioning for C-V2X"

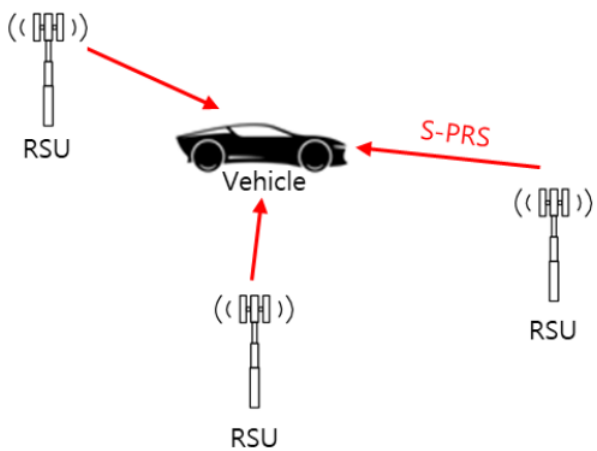


**Figure 7.5.1-2 An example of sidelink-based absolute positioning**

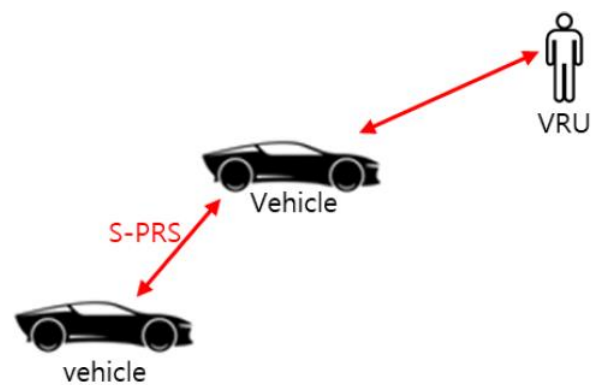


Figure 7.5.1-3 An example of sidelink-based relative positioning



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# Support of sidelink based positioning

- Sidelink based positioning can provide positioning solutions that can operate outside the network coverage.
  - ✓ Similarly to the sidelink operations 3GPP has specified so far, sidelink based positioning can also be operated inside network coverage under the network control.

## ❑ Consideration

- At least the following aspects need to be considered:
  - ✓ Design of sidelink positioning reference signals and necessary control signaling
  - ✓ Resource allocations for sidelink positioning reference signal transmission
  - ✓ UE procedure to transmit and receive sidelink positioning reference signals and to estimate UE position
  - ✓ Power efficiency for UEs with limited battery
- It should be possible for the sidelink based positioning to operate in a carrier shared with Rel-16/17 NR sidelink.

# Support of sidelink assisted positioning

## ❑ Motivation

- Once sidelink "based" positioning solutions are defined, they can be used in combination of conventional Uu-based positioning.
  - ✓ For example, sidelink can provide additional measurement information and thus has a potential to improve the positioning performance. This combination can be called sidelink "assisted" positioning.

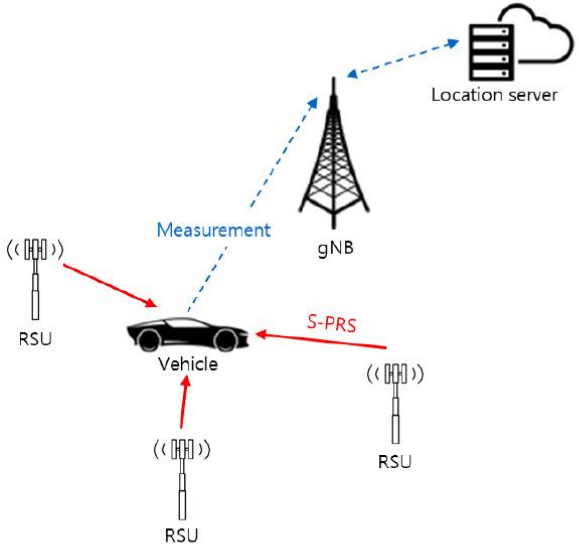


Figure from 5GAA TR "System Architecture and Solution Development; High-Accuracy Positioning for C-V2X"

**Figure 7.5.1-1 An example of sidelink-assisted positioning mode**

## ❑ Consideration

- It is expected that sidelink assisted positioning can reuse the design of the sidelink based positioning operated inside network coverage in many aspects.



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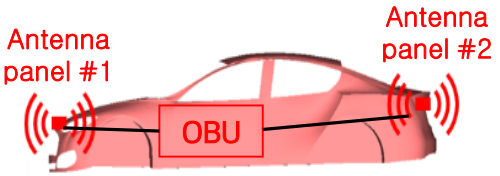
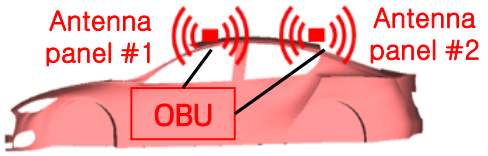
# Enhancements for UEs equipped with distributed antenna system

## ❑ Motivation

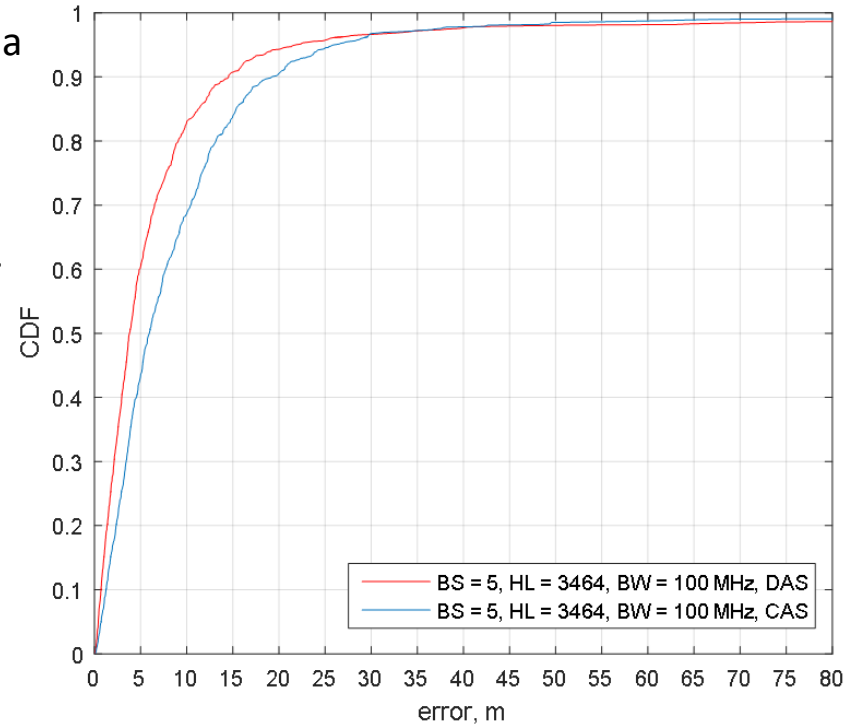
- Distributed antenna system (DAS), which means that a UE is equipped with multiple antenna panels placed at different locations, has been included in V2X evaluation methodology.
  - ✓ DAS modeling is defined in vehicle UE antenna model option 2 in TR 37.885.
  - ✓ The distance between two antenna panels can be several meters and much larger than the allowable positioning error. In TR 37.885, the length of vehicle type 1 in TR 37.885 is 5 meters and two panels in that type are placed in the front and rear bumper, respectively. Two panels are placed in the frond and rear roof tops with the same vehicle length in vehicle 2. In vehicle type 3, the length of the vehicle is 13 meters.
- DAS is being considered as an implementation solution which can provide the required antenna gain in all the directions.
  - ✓ This implementation can be beneficial both in Uu and sidelink.
- The positioning solutions specified so far considered a single antenna panel of each UE and they are unable to separate PRS transmissions and receptions in different panels.
  - ✓ Such limitation may cause inherent positioning error when applied to a DAS-equipped UE without further enhancements.



# Enhancements for UEs equipped with distributed antenna system

- DAS can also have a potential to improve the position performance by taking advantage of the multiple antenna panel locations.
  - ✓ Preliminary evaluation results comparing the positioning error in co-located antenna system (CAS) and DAS using DL-TDoA in a highway scenario of V2X evaluation methodology.




## ❑ Consideration

- Positioning enhancements are necessary to fulfill the positioning error requirement for V2X use cases in a vehicle equipped with DAS.
  - ✓ Such solution needs to cover both Uu and sidelink-based positioning.



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# Annex1: Evaluation assumption for DAS positioning

## ❑ Baseline assumptions for SLS

| Parameter | |
|---|---|
| Channel model, scenario | TR 37.885, Highway scenario |
| Carrier frequency | 4 GHz |
| Subcarrier spacing | 30 kHz |
| Bandwidth | 100 MHz |
| Measurement algorithm | Threshold-based ToA estimation method |
| Positioning technique | CHAN ML estimator |
| Network synchronization assumptions | Ideal synchronization |
| Wrap around | Disabled |
| Deployment | HL (Highway Length) = 3464m<br>6 lanes total with 4m width<br>5 BS with ISD = 0.5 HL |

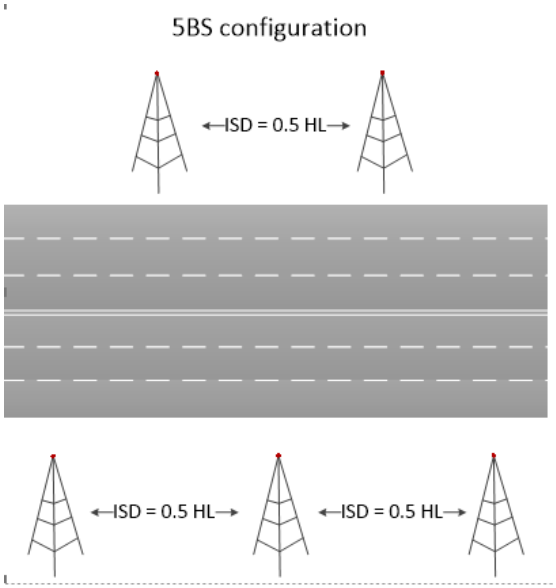
## ❑ BS antenna configuration

| Parameter | Value |
|---|---|
| Antenna array configuration<br>*(M, N, P, $M_g$, $N_g$)* | (8, 1, 2, 1, 1)<br>M – number of vertical elements on each panel<br>N – number of horizontal elements on each panel<br>P – number of polarizations<br>$M_g$ – number of vertical panels<br>$N_g$ – number of horizontal panels |
| Tilt angle | 96 degrees |
| Antenna array spacing<br>*($d_H$,$d_V$)* | ($d_H$, $d_V$) = (0.5, 0.8)λ<br>$d_H$ – space between two adjacent elements in horizontal direction<br>$d_V$ – space between two adjacent elements in vertical direction |
| Tx power | 49 dBm |
| Polarization | Cross-pol (± 45 deg) |
| Antenna element pattern | See 3GPP TR 37.885 Table 6.1.4-2 |

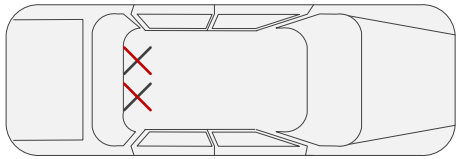
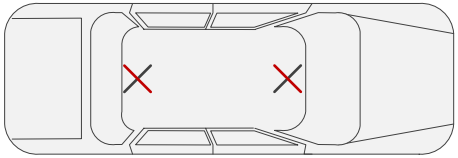
# Annex1: Evaluation assumption for DAS positioning

## ❑ Vehicle antenna configuration

| Parameter | Value |
|---|---|
| Antenna array configuration<br>(M, N, P, $M_g$, $N_g$) | (1, 1, 2, 1, 1) for each panel of DAS (i.e., one panel at the front rooftop and one panel at the rear rooftop)<br>(1, 2, 2, 1, 1) for CAS |
| Antenna array spacing<br>$(d_H, d_V)$ | $(d_H, d_V) = (0.5, 0.5)\lambda$ |
| Noise figure | 9 dB |
| Polarization | Cross-pol (0 and 90 deg) |
| Antenna element pattern | 3GPP TR 37.885 Table 6.1.4-10B, Table 6.1.4-10C |




CAS configuration



DAS configuraton