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| Technical Report | |
| 3rd Generation Partnership Project;  Technical Specification Group Radio Access Network;  Study on Expanded and Improved NR Positioning;  (Release 18) | |
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# B.1 Evaluation results for sidelink positioning

## B.1.1 Results from source [18]

### B.1.1.1 Description of evaluation scenarios

IIoT scenarios were evaluated for absolute positioning using sidelink positioning.

Table B.1.1.1-1 Assumptions for sidelink positioning evaluations for IIoT

|  |  |  |
| --- | --- | --- |
| **Scenario parameters** | |  |
| Carrier frequency, GHz | | 3.5GHz |
| Bandwidth, MHz | | 100MHz |
| - Subcarrier spacing, kHz | | - 30kHz |
| PHY/link level abstraction | | Explicit simulation of all links, individual parameters estimation is applied. SL signals other than SL PRS are not present. |
| UE RX and TX timing error | | - The network synchronization error, per UE dropping, is defined as a truncated Gaussian distribution of (T1 ns) rms values between an anchor UE and a timing reference source which is assumed to have perfect timing, subject to a largest timing difference of T2 ns, where T2 = 2\*T1  - That is, the range of timing errors is [-T2, T2]  - T1: 0ns (perfectly synchronized), 50ns (Optional) |
| - Channel model | | - InF-SH, InF-DH |
| Layout | Hall size | InF-SH: 300x150 m  InF-DH: 120x60 m |
| Room height | 10m |
| Penetration loss | | 0dB |
| Number of floors | | 1 |
| Clutter parameters: {density , height ,size } | | InF-SH (low clutter density): {20%, 2m, 10m}  InF-DH (high clutter density): {40%, 2m, 2m} |
| **UE model parameters** | |  |
| UE noise figure, dB | | 9dB – Note 1 |
| UE TX power, dBm | | 23dBm – Note 1 |
| UE antenna configuration | | Panel model 1 – Note 1  Mg = 1, Ng = 1, P = 2, dH = 0.5λ, (M, N, P, Mg, Ng) = (1, 1, 2, 1, 1) |
| UE antenna radiation pattern | | Omni, 0dBi |
| UE horizontal drop procedure | | 180 UEs are randomly distributed in the simulation area |
| UE antenna height | | 1.5m |
| UE mobility | | 3km/h |
| Min UE-UE distance (2D), m | | 1m |
| **Positioning parameters** | |  |
| Positioning method | | Taylor Series (based on least squares algorithm) |
| Description of Measurement Algorithm | | Thresholding 0.5, (Oversampling x4) |
| Reference Signal Physical Structure and Resource Allocation (RE pattern) | | Comb-6, 6 symbol NR PRS |
| Maximum number of anchor nodes | | 12 |
| Selection of anchor nodes | | LoS anchor nodes with smallest ToA to target UE |
| Note 1: According to TR 38.802  Note 2: According to TR 38.901 | | |

### B.1.1.2 Positioning accuracy evaluation results for Sidelink Positioning

#### B.1.1.2.1 Positioning accuracy evaluation results for Sidelink Positioning for IIoT

Table B.1.1.2.1-1 - Simulation results for IIOT for absolute positioning - horizontal accuracy (meters). Synchronization error among anchor nodes.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case #1, BW=100MHz, InF-SH, #UEs=180, No sync error | 0.19 | 0.267 | 0.408 | 0.732 | Yes | No, 54.1% of UEs satisfying the target positioning accuracy requirement |
| Case #2, BW=100MHz, InF-SH, #UEs=180, Sync error | 12.123 | 16.076 | 19.49 | 25.478 | No, 0% of UEs satisfying the target positioning accuracy requirement | No, 0% of UEs satisfying the target positioning accuracy requirement |

Table B.1.1.2.1-2 - Simulation results for IIOT for absolute positioning - horizontal accuracy (meters). Different number of deployed UEs.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #3, BW=100MHz, InF-SH, #UEs=72, No sync error | 0.222 | 0.309 | 0.659 | 3.193 | No, 85.5% of UEs satisfying the target positioning accuracy requirement | No, 42.3% of UEs satisfying the target positioning accuracy requirement |
| Case #4, BW=100MHz, InF-SH, #UEs=108, No sync error | 0.199 | 0.289 | 0.55 | 1.288 | No, 86.9% of UEs satisfying the target positioning accuracy requirement | No, 52.1% of UEs satisfying the target positioning accuracy requirement |
| Case #5, BW=100MHz, InF-SH, #UEs=144, No sync error | 0.183 | 0.254 | 0.409 | 0.824 | Yes | No, 56.9% of UEs satisfying the target positioning accuracy requirement |
| Case #6, BW=100MHz, InF-SH, #UEs=180, No sync error | 0.19 | 0.267 | 0.408 | 0.732 | Yes | No, 54.1% of UEs satisfying the target positioning accuracy requirement |

## B.1.2 Results from source [19]

### B.1.2.1 Description of evaluation scenarios

Common assumptions applicable to all evaluated scenarios that are different from or not provided in Tables A.1-1 through A.1-6 are provided in Table B.1.2.1-1.

Evaluation cases and relevant additional assumptions for highway scenarios for V2X use cases are provided in Table B.1.2.1-2 - Table B.1.2.1-4.

Evaluation cases and relevant additional assumptions for urban grid scenarios for V2X use cases are provided in Table B.1.2.1-5 - Table B.1.2.1-7.

Evaluation cases and relevant additional assumptions for IIoT use cases are provided in Table B.1.2.1-8 - Table B.1.2.1-9.

Evaluation cases and relevant additional assumptions for public safety use cases are provided in Table B.1.2.1-10 - Table B.1.2.1-11.

Evaluation cases and relevant additional assumptions for commercial use cases are provided in Table B.1.2.1-12 - Table B.1.2.1-13.

Table B.1.2.1-1: Common assumptions for sidelink positioning evaluations that are different from or not provided in Annex A.1 from [19]

|  |  |
| --- | --- |
| **Parameter** |  |
| Subcarrier spacing | 30kHz |
| Reference Signal Physical Structure and Resource Allocation (RE pattern) | Existing pattern and sequence of DL-PRS  (Comb-4, 4 symbol) |
| Reference signal including PRS, SRS and SL-PRS  (type of sequence, number of ports, …) | Gold, single port |
| Number of symbols used per occasion | 4 |
| number of occasions used per positioning estimate | 1 |
| Power-boosting level | 6dB |
| Uplink power control (applied/not applied) | Not applied |
| interference modelling (ideal muting, or other) | Ideal |
| Description of Measurement Algorithm (e.g. super resolution, interference cancellation, ….) | Super resolution |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | PSO |
| Synchronization assumptions | Ideal |
| UE/gNB RX and TX timing error assumption | Ideal |
| Precoding assumptions (codebook, nrof antenna elements used, etc) | Tx  codebook-based |

Table B.1.2.1-2: Assumptions for sidelink positioning in highway scenarios for V2X use cases that are different from or not provided in Annex A.1 from [19]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Case 1001** | **Case 1002** | **Case 1003** | **Case 1004** | **Case 1005** | **Case 1006** | **Case 1007** | **Case 1008** | **Case 1009** |
| Carrier frequency | Uu: 4GHz SL: 6GHz | | | | | | | | |
| UE or UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1)  dH=dV=0.5λ | | | | | | | | |
| TRP antenna model | UPA 4x4x2 | | | | | | | | |
| BS deployment for absolute positioning | / | | | UMa | | | / | | |
| RSU deployment for absolute positioning | 200m spacing on both sides of highway symmetrically | | | | | | Staggered on both sides of the highway with distance of 200m | | |
| Positioning method | RTT | | | | | | | | |
| Reference Signal Transmission Bandwidth | 20MHz | 40MHz | 100MHz | 20MHz | 40MHz | 100MHz | 20MHz | 40MHz | 100MHz |

Table B.1.2.1-3: Assumptions for sidelink positioning in highway scenarios for V2X use cases that are different from or not provided in Annex A.1 from [19]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Case 1101** | **Case 1102** | **Case 1103** | **Case 1104** | **Case 1105** | **Case 1106** | **Case 1107** | **Case 1108** | **Case 1109** |
| Carrier frequency | SL: 6GHz | | | | | | | | |
| UE or UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1)  dH=dV=0.5λ | | | | | | | | |
| BS deployment for relative positioning/ranging | / | | | | | | | | |
| RSU deployment for relative positioning/ranging | / | | | | | | 200m spacing on both sides of highway symmetrically | | |
| Positioning method | RTT+AOA | | | | | | | | |
| Reference Signal Transmission Bandwidth | 20MHz | 40MHz | 100MHz | 20MHz | 40MHz | 100MHz | 20MHz | 40MHz | 100MHz |
| Selected values of X (relative positioning or ranging is performed between two UEs within X m) | 50m | | | | | | | | |
| LOS condition between two UEs | LOS, NLOSv | | | | | | | | |

Table B.1.2.1-4: Assumptions for sidelink positioning in highway scenarios for V2X use cases that are different from or not provided in Annex A.1 from [19]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Case 1121** | **Case 1122** | **Case 1123** | **Case 1124** | **Case 1125** | **Case 1126** | **Case 1127** | **Case 1128** | **Case 1129** |
| Carrier frequency | SL: 6GHz | | | | | | | | |
| UE or UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1)  dH=dV=0.5λ | | | | | | | | |
| BS deployment for relative positioning/ranging | / | | | | | | | | |
| RSU deployment for relative positioning/ranging | / | | | | | | 200m spacing on both sides of highway symmetrically | | |
| Positioning method | RTT+AOA | | | | | | | | |
| Reference Signal Transmission Bandwidth | 20MHz | 40MHz | 100MHz | 20MHz | 40MHz | 100MHz | 20MHz | 40MHz | 100MHz |
| Selected values of X (relative positioning or ranging is performed between two UEs within X m) | 150m | | | | | | | | |
| LOS condition between two UEs | LOS, NLOSv | | | | | | | | |

Table B.1.2.1-5: Assumptions for sidelink positioning in urban grid scenarios for V2X use cases that are different from or not provided in Annex A.1 from [19]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Case 2001** | **Case 2002** | **Case 2003** | **Case 2004** | **Case 2005** | **Case 2006** |
| Carrier frequency | Uu: 4GHz SL: 6GHz | | | | | |
| UE or UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1)  dH=dV=0.5λ | | | | | |
| TRP antenna model | UPA 4x4x2 | | | | | |
| BS deployment for absolute positioning | / | | | UMa | | |
| RSU deployment for absolute positioning | In the middle of the crossroads | | | | | |
| Positioning method | RTT | | | | | |
| Reference Signal Transmission Bandwidth | 20MHz | 40MHz | 100MHz | 20MHz | 40MHz | 100MHz |

Table B.1.2.1-6: Assumptions for sidelink positioning in urban grid scenarios for V2X use cases that are different from or not provided in Annex A.1 from [19]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Case 2101** | **Case 2102** | **Case 2103** | **Case 2104** | **Case 2105** | **Case 2106** | **Case 2107** | **Case 2108** | **Case 2109** |
| Carrier frequency | SL: 6GHz | | | | | | | | |
| UE or UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1)  dH=dV=0.5λ | | | | | | | | |
| BS deployment for relative positioning/ranging | / | | | | | | UMa | | |
| RSU deployment for relative positioning/ranging | / | | | | | | In the middle of the crossroads | | |
| Positioning method | RTT+AOA | | | | | | | | |
| Reference Signal Transmission Bandwidth | 20  MHz | 40  MHz | 100  MHz | 20  MHz | 40  MHz | 100  MHz | 20  MHz | 40  MHz | 100  MHz |
| Selected values of X (relative positioning or ranging is performed between two UEs within X m) | 10m | | | | | | | | |
| LOS condition between two UEs | LOS, NLOSv | | | | | | | | |

Table B.1.2.1-7: Assumptions for sidelink positioning in urban grid scenarios for V2X use cases that are different from or not provided in Annex A.1 from [19]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Case 2121** | **Case 2122** | **Case 2123** | **Case 2124** | **Case 2125** | **Case 2126** | **Case 2127** | **Case 2128** | **Case 2129** |
| Carrier frequency | SL: 6GHz | | | | | | | | |
| UE or UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1)  dH=dV=0.5λ | | | | | | | | |
| BS deployment for relative positioning/ranging | / | | | | | | UMa | | |
| RSU deployment for relative positioning/ranging | / | | | | | | In the middle of the crossroads | | |
| Positioning method | RTT+AOA | | | | | | | | |
| Reference Signal Transmission Bandwidth | 20  MHz | 40  MHz | 100  MHz | 20  MHz | 40  MHz | 100  MHz | 20  MHz | 40  MHz | 100  MHz |
| Selected values of X (relative positioning or ranging is performed between two UEs within X m) | 50m | | | | | | | | |
| LOS condition between two UEs | LOS, NLOSv | | | | | | | | |

Table B.1.2.1-8: Assumptions for sidelink positioning for IIoT use cases that are different from or not provided in Annex A.1 from [19]

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Case 5001** | **Case 5002** | **Case 5003** | **Case 5004** | **Case 5005** | **Case 5006** | **Case 5007** | **Case 5008** | **Case 5009** | **Case 5010** | **Case 5011** | **Case 5012** |
| Carrier frequency | Uu: 3.5GHz SL: 3.5GHz | | | | | | | | | | | |
| UE or UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1)  dH=dV=0.5λ | | | | | | | | | | | |
| TRP antenna model | UPA 4x4x2 | | | | | | | | | | | |
| BS deployment for absolute positioning | / | | | 18 BSs on a square lattice with spacing 50m | | | / | | | 18 BSs on a square lattice with spacing 20m | | |
| RSU deployment for absolute positioning | Distributed on a square lattice with spacing 50m near the wall and at the center of each square of 4 BSs (4×7, 28 in total) | | | | | | Distributed on a square lattice with spacing 20m near the wall and at the center of each square of 4 BSs (4×7, 28 in total) | | | | | |
| Positioning method | RTT | | | | | | | | | | | |
| Reference Signal Transmission Bandwidth | 20  MHz | 40  MHz | 100  MHz | 20  MHz | 40  MHz | 100  MHz | 20  MHz | 40  MHz | 100  MHz | 20  MHz | 40  MHz | 100  MHz |

Table B.1.2.1-9: Assumptions for sidelink positioning for IIoT use cases that are different from or not provided in Annex A.1 from [19]

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Case 5101** | **Case 5102** | **Case 5103** | **Case 5104** | **Case 5105** | **Case 5106** | **Case 5107** | **Case 5108** | **Case 5109** | **Case 5110** | **Case 5111** | **Case 5112** |
| Carrier frequency | SL: 3.5GHz | | | | | | | | | | | |
| UE or UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1)  dH=dV=0.5λ | | | | | | | | | | | |
| RSU deployment for relative positioning/ranging | / | | | Distributed on a square lattice with spacing 50m near the wall and at the center of each square of 4 BSs (4×7, 28 in total) | | | / | | | Distributed on a square lattice with spacing 20m near the wall and at the center of each square of 4 BSs (4×7, 28 in total) | | |
| Positioning method | RTT+AOA | | | | | | | | | | | |
| Reference Signal Transmission Bandwidth | 20  MHz | 40  MHz | 100  MHz | 20  MHz | 40  MHz | 100  MHz | 20  MHz | 40  MHz | 100  MHz | 20  MHz | 40  MHz | 100  MHz |
| Selected values of X (relative positioning or ranging is performed between two UEs within X m) | 10m | | | | | | | | | | | |
| LOS condition between two UEs | LOS, NLOS | | | | | | | | | | | |

Table B.1.2.1-10: Assumptions for sidelink positioning for public safety use cases that are different from or not provided in Annex A.1 from [19]

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Case 3001** | **Case 3002** | **Case 3003** | **Case 3004** | **Case 3005** | **Case 3006** | **Case 3007** | **Case 3008** |
| Carrier frequency | Uu: 3.5GHz SL: 0.7GHz | | | | | | | |
| UE or UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1)  dH=dV=0.5λ | | | | | | | |
| TRP antenna model | UPA 4x4x2 | | | | | | | |
| BS deployment for absolute positioning | / | | | | UMa | | | |
| RSU deployment for absolute positioning | Distributed on a square lattice with spacing 200m (4×4, 16 in total) | | | | | | | |
| Positioning method | RTT | | | | | | | |
| Reference Signal Transmission Bandwidth | 10MHz | 20MHz | 40MHz | 100MHz | 10MHz | 20MHz | 40MHz | 100MHz |

Table B.1.2.1-11: Assumptions for sidelink positioning for public safety use cases that are different from or not provided in Annex A.1 from [19]

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Case 3101** | **Case 3102** | **Case 3103** | **Case 3104** | **Case 3105** | **Case 3106** | **Case 3107** | **Case 3108** |
| Carrier frequency | SL: 0.7GHz | | | | | | | |
| UE or UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1)  dH=dV=0.5λ | | | | | | | |
| RSU deployment for relative positioning/ranging | / | | | | Distributed on a square lattice with spacing 200m (4×4, 16 in total) | | | |
| Positioning method | RTT+AOA | | | | | | | |
| Reference Signal Transmission Bandwidth | 10MHz | 20MHz | 40MHz | 100MHz | 10MHz | 20MHz | 40MHz | 100MHz |
| Selected values of X (relative positioning or ranging is performed between two UEs within X m) | 20m | | | | | | | |
| LOS condition between two UEs | LOS | | | | | | | |

Table B.1.2.1-12: Assumptions for sidelink positioning for commercial use cases that are different from or not provided in Annex A.1 from [19]

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Case 4001** | **Case 4002** | **Case 4003** |
| Carrier frequency | SL: 3.5GHz | | |
| UE or UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1)  dH=dV=0.5λ | | |
| TRP antenna model | UPA 4x4x2 | | |
| RSU deployment for absolute positioning | Distributed on a square lattice with spacing 20m (6×2, 12 in total) | | |
| Positioning method | RTT | | |
| Reference Signal Transmission Bandwidth | 20MHz | 40MHz | 100MHz |

Table B.1.2.1-13: Assumptions for sidelink positioning for commercial use cases that are different from or not provided in Annex A.1 from [19]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Case 4101** | **Case 4102** | **Case 4103** | **Case 4104** | **Case 4105** | **Case 4106** |
| Carrier frequency | SL: 3.5GHz | | | | | |
| UE or UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1)  dH=dV=0.5λ | | | | | |
| RSU deployment for relative positioning | / | | | Distributed on a square lattice with spacing 20m (6×2, 12 in total) | | |
| Positioning method | RTT+AOA | | | | | |
| Reference Signal Transmission Bandwidth | 20MHz | 40MHz | 100MHz | 20MHz | 40MHz | 100MHz |
| Selected values of X (relative positioning or ranging is performed between two UEs within X m) | 10m | | | | | |
| LOS condition between two UEs | LOS | | | | | |

### B.1.2.2 Positioning accuracy evaluation results for Sidelink Positioning

#### B.1.2.2.1 Positioning accuracy evaluation results for Sidelink Positioning for Highway Scenarios for V2X

Table B.1.2.2.1-1 provides horizontal absolute positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.2.2.1-2 provides horizontal relative positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.2.2.1-3 provides ranging distance accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.2.2.1-4 provides ranging angle accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.2.2.1-1: Sidelink positioning - horizontal absolute accuracy for highway scenarios for V2X use cases from [19]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| **1001, V2X, Highway, [RSU], 20MHz, RTT, Absolute** | 0.570 | 0.828 | 1.165 | 1.631 | 87% | 44% |
| **1002, V2X, Highway, [RSU], 40MHz, RTT, Absolute** | 0.383 | 0.586 | 0.861 | 1.231 | Yes | 61% |
| **1003, V2X, Highway, [RSU], 100MHz, RTT, Absolute** | 0.120 | 0.183 | 0.275 | 0.432 | Yes | Yes |
| **1004, V2X, Highway, [BS,RSU], 20MHz, RTT, Absolute** | 0.440 | 0.691 | 0.968 | 1.458 | Yes | 55% |
| **1005, V2X, Highway, [BS,RSU], 40MHz, RTT, Absolute** | 0.325 | 0.484 | 0.741 | 1.091 | Yes | 68% |
| **1006, V2X, Highway, [BS,RSU], 100MHz, RTT, Absolute** | 0.106 | 0.162 | 0.253 | 0.429 | Yes | Yes |
| **1007, V2X, Highway, [StaggerRSU], 20MHz, RTT, Absolute** | 0.554 | 0.832 | 1.320 | 1.844 | 85% | 47% |
| **1008, V2X, Highway, [StaggerRSU], 40MHz, RTT, Absolute** | 0.404 | 0.602 | 0.916 | 1.415 | Yes | 58% |
| **1009, V2X, Highway, [StaggerRSU], 100MHz, RTT, Absolute** | 0.123 | 0.202 | 0.313 | 0.494 | Yes | Yes |

Table B.1.2.2.1-2: Sidelink positioning - horizontal relative accuracy for highway scenarios for V2X use cases from [19]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| **1101, V2X, Highway, [UE], 20MHz, RTT+AOA, Relative, X=50m** | 0.902 | 1.438 | 2.253 | 3.448 | 68% | 26% |
| **1102, V2X, Highway, [UE], 40MHz, RTT+AOA, Relative, X=50m** | 0.674 | 1.144 | 1.886 | 2.785 | 74% | 37% |
| **1103, V2X, Highway, [UE], 100MHz, RTT+AOA, Relative, X=50m** | 0.482 | 0.773 | 1.210 | 2.148 | 84% | 53% |
| **1104, V2X, Highway, [UE], 20MHz, RTT+AOA, LOS-only, Relative, X=50m** | 0.869 | 1.350 | 2.071 | 2.954 | 70% | 28% |
| **1105, V2X, Highway, [UE], 40MHz, RTT+AOA, LOS-only, Relative, X=50m** | 0.651 | 1.065 | 1.763 | 2.551 | 77% | 38% |
| **1106, V2X, Highway, [UE], 100MHz, RTT+AOA, LOS-only, Relative, X=50m** | 0.273 | 0.402 | 0.599 | 0.955 | Yes | 72% |
| **1107, V2X, Highway, [UE,RSU], 20MHz, RTT+AOA, Relative, X=50m** | 0.561 | 0.807 | 1.137 | 1.571 | 89% | 45% |
| **1108, V2X, Highway, [UE,RSU], 40MHz, RTT+AOA, Relative, X=50m** | 0.373 | 0.573 | 0.819 | 1.182 | Yes | 62% |
| **1109, V2X, Highway, [UE,RSU], 100MHz, RTT+AOA, Relative, X=50m** | 0.119 | 0.180 | 0.264 | 0.407 | Yes | Yes |
| **1121, V2X, Highway, [UE], 20MHz, RTT+AOA, Relative, X=150m** | 3.286 | 5.992 | 10.899 | 24.749 | 29% | 10% |
| **1122, V2X, Highway, [UE], 40MHz, RTT+AOA, Relative, X=150m** | 2.544 | 4.691 | 8.469 | 22.251 | 36% | 15% |
| **1123, V2X, Highway, [UE], 100MHz, RTT+AOA, Relative, X=150m** | 1.665 | 3.319 | 6.495 | 24.901 | 47% | 24% |
| **1124, V2X, Highway, [UE], 20MHz, RTT+AOA, LOS-only, Relative, X=150m** | 2.629 | 4.79 | 7.165 | 11.099 | 33% | 12% |
| **1125, V2X, Highway, [UE], 40MHz, RTT+AOA, LOS-only, Relative, X=150m** | 2.017 | 3.326 | 5.318 | 8.364 | 38% | 17% |
| **1126, V2X, Highway, [UE], 100MHz, RTT+AOA, LOS-only, Relative, X=150m** | 1.294 | 2.407 | 3.971 | 6.256 | 57% | 27% |
| **1127, V2X, Highway, [UE,RSU], 20MHz, RTT+AOA, Relative, X=150m** | 0.980 | 1.547 | 2.280 | 3.636 | 65% | 25% |
| **1128, V2X, Highway, [UE,RSU], 40MHz, RTT+AOA, Relative, X=150m** | 0.735 | 1.097 | 1.650 | 2.445 | 77% | 37% |
| **1129, V2X, Highway, [UE,RSU], 100MHz, RTT+AOA, Relative, X=150m** | 0.252 | 0.384 | 0.609 | 1.046 | Yes | 75% |

Table B.1.2.2.1-3: Sidelink positioning - ranging distance accuracy for highway scenarios for V2X use cases from [19]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| **1101, V2X, Highway, [UE], 20MHz, Relative, X=50m** | 0.234 | 0.369 | 0.524 | 0.749 | Yes | 78% |
| **1102, V2X, Highway, [UE], 40MHz, Relative, X=50m** | 0.160 | 0.226 | 0.332 | 0.451 | Yes | Yes |
| **1103, V2X, Highway, [UE], 100MHz, Relative, X=50m** | 0.045 | 0.070 | 0.102 | 0.148 | Yes | Yes |
| **1104, V2X, Highway, [UE], 20MHz, RTT+AOA, LOS-only, Relative, X=50m** | 0.226 | 0.351 | 0.495 | 0.687 | Yes | 81% |
| **1105, V2X, Highway, [UE], 40MHz, RTT+AOA, LOS-only, Relative, X=50m** | 0.155 | 0.221 | 0.309 | 0.430 | Yes | Yes |
| **1106, V2X, Highway, [UE], 100MHz, RTT+AOA, LOS-only, Relative, X=50m** | 0.044 | 0.067 | 0.094 | 0.137 | Yes | Yes |
| **1107, V2X, Highway, [UE,RSU], 20MHz, RTT+AOA, Relative, X=50m** | 0.193 | 0.323 | 0.481 | 0.732 | Yes | 82% |
| **1108, V2X, Highway, [UE,RSU], 40MHz, RTT+AOA, Relative, X=50m** | 0.153 | 0.232 | 0.347 | 0.502 | Yes | 89% |
| **1109, V2X, Highway, [UE,RSU], 100MHz, RTT+AOA, Relative, X=50m** | 0.049 | 0.077 | 0.115 | 0.176 | Yes | Yes |
| **1121, V2X, Highway, [UE], 20MHz, Relative, X=150m** | 0.246 | 0.396 | 0.656 | 1.343 | Yes | 72% |
| **1122, V2X, Highway, [UE], 40MHz, Relative, X=150m** | 0.172 | 0.267 | 0.419 | 0.747 | Yes | 84% |
| **1123, V2X, Highway, [UE], 100MHz, Relative, X=150m** | 0.056 | 0.092 | 0.148 | 0.248 | Yes | Yes |
| **1124, V2X, Highway, [UE], 20MHz, RTT+AOA, LOS-only, Relative, X=150m** | 0.217 | 0.316 | 0.470 | 0.688 | Yes | 82% |
| **1125, V2X, Highway, [UE], 40MHz, RTT+AOA, LOS-only, Relative, X=150m** | 0.152 | 0.219 | 0.305 | 0.451 | Yes | Yes |
| **1126, V2X, Highway, [UE], 100MHz, RTT+AOA, LOS-only, Relative, X=150m** | 0.047 | 0.073 | 0.106 | 0.154 | Yes | Yes |
| **1127, V2X, Highway, [UE,RSU], 20MHz, RTT+AOA, Relative, X=150m** | 0.226 | 0.335 | 0.513 | 0.943 | Yes | 79% |
| **1128, V2X, Highway, [UE,RSU], 40MHz, RTT+AOA, Relative, X=150m** | 0.158 | 0.238 | 0.340 | 0.573 | Yes | 86% |
| **1129, V2X, Highway, [UE,RSU], 100MHz, RTT+AOA, Relative, X=150m** | 0.053 | 0.081 | 0.120 | 0.200 | Yes | Yes |

Table B.1.2.2.1-4: Sidelink positioning - ranging angle accuracy for highway scenarios for V2X use cases from [19]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| **1101, V2X, Highway, [UE], 20MHz, Relative, X=50m** | 1.800 | 2.973 | 4.412 | 6.549 | Yes | Yes |
| **1102, V2X, Highway, [UE], 40MHz, Relative, X=50m** | 1.449 | 2.463 | 3.624 | 5.600 | Yes | Yes |
| **1103, V2X, Highway, [UE], 100MHz, Relative, X=50m** | 1.086 | 1.673 | 2.704 | 4.348 | Yes | Yes |
| **1104, V2X, Highway, [UE], 20MHz, RTT+AOA, LOS-only, Relative, X=50m** | 1.721 | 2.846 | 3.980 | 5.881 | Yes | Yes |
| **1105, V2X, Highway, [UE], 40MHz, RTT+AOA, LOS-only, Relative, X=50m** | 1.357 | 2.316 | 3.362 | 4.756 | Yes | Yes |
| **1106, V2X, Highway, [UE], 100MHz, RTT+AOA, LOS-only, Relative, X=50m** | 1.030 | 1.600 | 2.446 | 3.805 | Yes | Yes |
| **1107, V2X, Highway, [UE,RSU], 20MHz, RTT+AOA, Relative, X=50m** | 0.874 | 1.553 | 2.353 | 4.423 | Yes | Yes |
| **1108, V2X, Highway, [UE,RSU], 40MHz, RTT+AOA, Relative, X=50m** | 0.574 | 1.016 | 1.817 | 3.129 | Yes | Yes |
| **1109, V2X, Highway, [UE,RSU], 100MHz, RTT+AOA, Relative, X=50m** | 0.192 | 0.349 | 0.633 | 1.029 | Yes | Yes |
| **1121, V2X, Highway, [UE], 20MHz, Relative, X=150m** | 2.949 | 4.8 | 7.531 | 15.959 | 89% | 81% |
| **1122, V2X, Highway, [UE], 40MHz, Relative, X=150m** | 2.119 | 3.79 | 5.775 | 16.8 | 89% | 85% |
| **1123, V2X, Highway, [UE], 100MHz, Relative, X=150m** | 1.495 | 2.562 | 4.358 | 15.948 | 89% | 86% |
| **1124, V2X, Highway, [UE], 20MHz, RTT+AOA, LOS-only, Relative, X=150m** | 2.4 | 4.021 | 5.333 | 7.683 | Yes | Yes |
| **1125, V2X, Highway, [UE], 40MHz, RTT+AOA, LOS-only, Relative, X=150m** | 1.819 | 2.834 | 4.12 | 5.744 | Yes | Yes |
| **1126, V2X, Highway, [UE], 100MHz, RTT+AOA, LOS-only, Relative, X=150m** | 1.256 | 1.983 | 2.885 | 4.132 | Yes | Yes |
| **1127, V2X, Highway, [UE,RSU], 20MHz, RTT+AOA, Relative, X=150m** | 0.762 | 1.242 | 1.929 | 3.490 | Yes | Yes |
| **1128, V2X, Highway, [UE,RSU], 40MHz, RTT+AOA, Relative, X=150m** | 0.554 | 0.932 | 1.448 | 2.382 | Yes | Yes |
| **1129, V2X, Highway, [UE,RSU], 100MHz, RTT+AOA, Relative, X=150m** | 0.195 | 0.336 | 0.532 | 1.205 | Yes | Yes |

#### B.1.2.2.2 Positioning accuracy evaluation results for Sidelink Positioning for Urban Grid Scenarios for V2X

Table B.1.2.2.2-1 provides horizontal absolute positioning accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.2.2.2-2 provides horizontal relative positioning accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.2.2.2-3 provides ranging distance accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.2.2.2-4 provides ranging angle accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.2.2.2-1: Sidelink positioning - horizontal absolute accuracy for urban grid scenarios for V2X use cases from [19]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| **2001, V2X, UrbanGrid, [RSU], 20MHz, RTT, Absolute** | 4.749 | 6.996 | 9.938 | 16.222 | 15% | 4% |
| **2002, V2X, UrbanGrid, [RSU], 40MHz, RTT, Absolute** | 3.911 | 7.001 | 10.070 | 12.726 | 20% | 8% |
| **2003, V2X, UrbanGrid, [RSU], 100MHz, RTT, Absolute** | 3.509 | 5.782 | 7.88 | 10.489 | 20% | 17% |
| **2004, V2X, UrbanGrid, [BS,RSU], 20MHz, RTT, Absolute** | 0.331 | 0.604 | 1.130 | 3.187 | 84% | 63% |
| **2005, V2X, UrbanGrid, [BS,RSU], 40MHz, RTT, Absolute** | 0.258 | 0.548 | 1.100 | 2.777 | 84% | 65% |
| **2006, V2X, UrbanGrid, [BS,RSU], 100MHz, RTT, Absolute** | 0.181 | 0.361 | 0.628 | 1.628 | 89% | 76% |

Table B.1.2.2.2-2: Sidelink positioning - horizontal relative accuracy for urban grid scenarios for V2X use cases from [19]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| **2101, V2X, UrbanGrid, [UE], 20MHz, RTT+AOA, Relative, X=10m** | 1.072 | 1.621 | 2.485 | 4.254 | 64% | 20% |
| **2102, V2X, UrbanGrid, [UE], 40MHz, RTT+AOA, Relative, X=10m** | 0.878 | 1.203 | 1.723 | 2.614 | 75% | 24% |
| **2103, V2X, UrbanGrid, [UE], 100MHz, RTT+AOA, Relative, X=10m** | 0.286 | 0.403 | 0.621 | 0.974 | Yes | 73% |
| **2104, V2X, UrbanGrid, [UE], 20MHz, RTT+AOA, LOS-only, Relative, X=10m** | 1.014 | 1.507 | 2.290 | 3.423 | 66% | 22% |
| **2105, V2X, UrbanGrid, [UE], 40MHz, RTT+AOA, LOS-only, Relative, X=10m** | 0.848 | 1.129 | 1.548 | 2.300 | 78% | 26% |
| **2106, V2X, UrbanGrid, [UE], 100MHz, RTT+AOA, LOS-only, Relative, X=10m** | 0.270 | 0.379 | 0.554 | 0.808 | Yes | 75% |
| **2107, V2X, UrbanGrid, [BS,RSU,UE], 20MHz, RTT+AOA, Relative, X=10m** | 0.99 | 1.459 | 2.261 | 3.416 | 67% | 22% |
| **2108, V2X, UrbanGrid, [BS,RSU,UE], 40MHz, RTT+AOA, Relative, X=10m** | 0.814 | 1.087 | 1.523 | 2.269 | 79% | 33% |
| **2109, V2X, UrbanGrid, [BS,RSU,UE], 100MHz, RTT+AOA, Relative, X=10m** | 0.270 | 0.379 | 0.554 | 0.806 | Yes | 78% |
| **2121, V2X, UrbanGrid, [UE], 20MHz, RTT+AOA, Relative, X=50m** | 1.090 | 1.706 | 2.755 | 5.256 | 62% | 18% |
| **2122, V2X, UrbanGrid, [UE], 40MHz, RTT+AOA, Relative, X=50m** | 0.796 | 1.163 | 1.732 | 3.010 | 75% | 29% |
| **2123, V2X, UrbanGrid, [UE], 100MHz, RTT+AOA, Relative, X=50m** | 0.302 | 0.476 | 0.785 | 1.655 | 89% | 68% |
| **2124, V2X, UrbanGrid, [UE], 20MHz, RTT+AOA, LOS-only, Relative, X=50m** | 1.025 | 1.543 | 2.324 | 4.235 | 66% | 19% |
| **2125, V2X, UrbanGrid, [UE], 40MHz, RTT+AOA, LOS-only, Relative, X=50m** | 0.755 | 1.096 | 1.551 | 2.457 | 78% | 31% |
| **2126, V2X, UrbanGrid, [UE], 100MHz, RTT+AOA, LOS-only, Relative, X=50m** | 0.280 | 0.439 | 0.671 | 1.071 | Yes | 72% |
| **2127, V2X, UrbanGrid, [BS,RSU,UE], 20MHz, RTT+AOA, Relative, X=50m** | 1.001 | 1.500 | 2.316 | 4.233 | 67% | 25% |
| **2128, V2X, UrbanGrid, [BS,RSU,UE], 40MHz, RTT+AOA, Relative, X=50m** | 0.732 | 1.077 | 1.535 | 2.466 | 79% | 32% |
| **2129, V2X, UrbanGrid, [BS,RSU,UE], 100MHz, RTT+AOA, Relative, X=50m** | 0.275 | 0.422 | 0.671 | 1.060 | Yes | 72% |

Table B.1.2.2.2-3: Sidelink positioning - ranging distance accuracy for urban grid scenarios for V2X use cases from [19]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| **2101, V2X, UrbanGrid, [UE], 20MHz, RTT+AOA, Relative, X=10m** | 0.736 | 1.261 | 2.066 | 3.387 | 70% | 38% |
| **2102, V2X, UrbanGrid, [UE], 40MHz, RTT+AOA, Relative, X=10m** | 0.605 | 0.898 | 1.280 | 2.063 | 83% | 42% |
| **2103, V2X, UrbanGrid, [UE], 100MHz, RTT+AOA, Relative, X=10m** | 0.090 | 0.141 | 0.208 | 0.286 | Yes | Yes |
| **2104, V2X, UrbanGrid, [UE], 20MHz, RTT+AOA, LOS-only, Relative, X=10m** | 0.752 | 1.219 | 1.831 | 2.999 | 72% | 39% |
| **2105, V2X, UrbanGrid, [UE], 40MHz, RTT+AOA, LOS-only, Relative, X=10m** | 0.606 | 0.888 | 1.258 | 1.997 | 84% | 42% |
| **2106, V2X, UrbanGrid, [UE], 100MHz, RTT+AOA, LOS-only, Relative, X=10m** | 0.084 | 0.136 | 0.197 | 0.275 | Yes | Yes |
| **2107, V2X, UrbanGrid, [BS,RSU,UE], 20MHz, RTT+AOA, Relative, X=10m** | 0.697 | 1.175 | 1.801 | 2.990 | 75% | 39% |
| **2108, V2X, UrbanGrid, [BS,RSU,UE], 40MHz, RTT+AOA, Relative, X=10m** | 0.566 | 0.865 | 1.238 | 1.938 | 85% | 43% |
| **2109, V2X, UrbanGrid, [BS,RSU,UE], 100MHz, RTT+AOA, Relative, X=10m** | 0.085 | 0.137 | 0.199 | 0.281 | Yes | Yes |
| **2121, V2X, UrbanGrid, [UE], 20MHz, RTT+AOA, Relative, X=50m** | 0.748 | 1.190 | 1.902 | 3.487 | 74% | 39% |
| **2122, V2X, UrbanGrid, [UE], 40MHz, RTT+AOA, Relative, X=50m** | 0.505 | 0.776 | 1.146 | 1.843 | 84% | 49% |
| **2123, V2X, UrbanGrid, [UE], 100MHz, RTT+AOA, Relative, X=50m** | 0.091 | 0.148 | 0.208 | 0.281 | Yes | Yes |
| **2124, V2X, UrbanGrid, [UE], 20MHz, RTT+AOA, LOS-only, Relative, X=50m** | 0.698 | 1.125 | 1.728 | 2.899 | 76% | 41% |
| **2125, V2X, UrbanGrid, [UE], 40MHz, RTT+AOA, LOS-only, Relative, X=50m** | 0.493 | 0.745 | 1.052 | 1.571 | 89% | 50% |
| **2126, V2X, UrbanGrid, [UE], 100MHz, RTT+AOA, LOS-only, Relative, X=50m** | 0.087 | 0.138 | 0.196 | 0.255 | Yes | Yes |
| **2127, V2X, UrbanGrid, [BS,RSU,UE], 20MHz, RTT+AOA, Relative, X=50m** | 0.674 | 1.101 | 1.717 | 2.920 | 76% | 39% |
| **2128, V2X, UrbanGrid, [BS,RSU,UE], 40MHz, RTT+AOA, Relative, X=50m** | 0.486 | 0.718 | 1.047 | 1.586 | 89% | 51% |
| **2129, V2X, UrbanGrid, [BS,RSU,UE], 100MHz, RTT+AOA, Relative, X=50m** | 0.085 | 0.137 | 0.198 | 0.251 | Yes | Yes |

Table B.1.2.2.2-4: Sidelink positioning - ranging angle accuracy for urban grid scenarios for V2X use cases from [19]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| **2101, V2X, UrbanGrid, [UE], 20MHz, RTT+AOA, Relative, X=10m** | 3.309 | 5.358 | 8.345 | 14.954 | Yes | 79% |
| **2102, V2X, UrbanGrid, [UE], 40MHz, RTT+AOA, Relative, X=10m** | 2.710 | 4.160 | 6.544 | 12.487 | Yes | 85% |
| **2103, V2X, UrbanGrid, [UE], 100MHz, RTT+AOA, Relative, X=10m** | 1.988 | 3.220 | 4.914 | 8.660 | Yes | 89% |
| **2104, V2X, UrbanGrid, [UE], 20MHz, RTT+AOA, LOS-only, Relative, X=10m** | 3.036 | 4.791 | 6.857 | 10.081 | Yes | 81% |
| **2105, V2X, UrbanGrid, [UE], 40MHz, RTT+AOA, LOS-only, Relative, X=10m** | 2.457 | 3.648 | 5.489 | 8.059 | Yes | 89% |
| **2106, V2X, UrbanGrid, [UE], 100MHz, RTT+AOA, LOS-only, Relative, X=10m** | 1.813 | 2.932 | 4.320 | 6.125 | Yes | Yes |
| **2107, V2X, UrbanGrid, [BS,RSU,UE], 20MHz, RTT+AOA, Relative, X=10m** | 2.839 | 4.462 | 6.444 | 9.690 | Yes | 86% |
| **2108, V2X, UrbanGrid, [BS,RSU,UE], 40MHz, RTT+AOA, Relative, X=10m** | 2.267 | 3.393 | 4.910 | 7.367 | Yes | Yes |
| **2109, V2X, UrbanGrid, [BS,RSU,UE], 100MHz, RTT+AOA, Relative, X=10m** | 1.710 | 2.750 | 3.922 | 5.793 | Yes | Yes |
| **2121, V2X, UrbanGrid, [UE], 20MHz, RTT+AOA, Relative, X=50m** | 2.933 | 4.805 | 7.909 | 15.600 | 89% | 80% |
| **2122, V2X, UrbanGrid, [UE], 40MHz, RTT+AOA, Relative, X=50m** | 2.320 | 3.820 | 6.380 | 12.634 | Yes | 85% |
| **2123, V2X, UrbanGrid, [UE], 100MHz, RTT+AOA, Relative, X=50m** | 1.847 | 3.083 | 5.070 | 10.245 | Yes | 87% |
| **2124, V2X, UrbanGrid, [UE], 20MHz, RTT+AOA, LOS-only, Relative, X=50m** | 2.780 | 4.498 | 6.856 | 11.521 | Yes | 82% |
| **2125, V2X, UrbanGrid, [UE], 40MHz, RTT+AOA, LOS-only, Relative, X=50m** | 2.220 | 3.491 | 5.400 | 9.473 | Yes | 87% |
| **2126, V2X, UrbanGrid, [UE], 100MHz, RTT+AOA, LOS-only, Relative, X=50m** | 1.780 | 2.815 | 4.409 | 7.180 | Yes | Yes |
| **2127, V2X, UrbanGrid, [BS,RSU,UE], 20MHz, RTT+AOA, Relative, X=50m** | 2.663 | 4.420 | 6.826 | 11.286 | Yes | 82% |
| **2128, V2X, UrbanGrid, [BS,RSU,UE], 40MHz, RTT+AOA, Relative, X=50m** | 2.146 | 3.380 | 5.382 | 9.473 | Yes | 88% |
| **2129, V2X, UrbanGrid, [BS,RSU,UE], 100MHz, RTT+AOA, Relative, X=50m** | 1.719 | 2.765 | 4.233 | 7.174 | Yes | Yes |

#### B.1.2.2.3 Positioning accuracy evaluation results for Sidelink Positioning for IIoT

Table B.1.2.2.3-1 provides horizontal absolute positioning accuracy results using sidelink positioning for IIoT use cases.

Table B.1.2.2.3-2 provides horizontal relative positioning accuracy results using sidelink positioning for IIoT use cases.

Table B.1.2.2.3-1: Sidelink positioning - horizontal absolute accuracy for IIoT use cases from [19]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| **5001, IIOT, SH, [RSU], 20MHz, RTT, Absolute** | 0.649 | 0.975 | 1.336 | 2.084 | 67% | 39% |
| **5002, IIOT, SH, [RSU], 40MHz, RTT, Absolute** | 0.274 | 0.392 | 0.557 | 0.791 | Yes | 45% |
| **5003, IIOT, SH, [RSU], 100MHz, RTT, Absolute** | 0.058 | 0.092 | 0.130 | 0.182 | Yes | Yes |
| **5004, IIOT, SH, [BS,RSU], 20MHz, RTT, Absolute** | 0.046 | 0.073 | 0.115 | 0.215 | Yes | 89% |
| **5005, IIOT, SH, [BS,RSU], 40MHz, RTT, Absolute** | 0.045 | 0.072 | 0.114 | 0.178 | Yes | Yes |
| **5006, IIOT, SH, [BS,RSU], 100MHz, RTT, Absolute** | 0.030 | 0.040 | 0.057 | 0.085 | Yes | Yes |
| **5007, IIOT, DH, [RSU], 20MHz, RTT, Absolute** | 0.914 | 1.363 | 1.835 | 2.710 | 54% | 6% |
| **5008, IIOT, DH, [RSU], 40MHz, RTT, Absolute** | 0.362 | 0.540 | 0.735 | 0.972 | Yes | 25% |
| **5009, IIOT, DH, [RSU], 100MHz, RTT, Absolute** | 0.065 | 0.098 | 0.135 | 0.196 | Yes | Yes |
| **5010, IIOT, DH, [BS,RSU], 20MHz, RTT, Absolute** | 0.070 | 0.114 | 0.182 | 0.320 | Yes | 81% |
| **5011, IIOT, DH, [BS,RSU], 40MHz, RTT, Absolute** | 0.065 | 0.103 | 0.166 | 0.287 | Yes | 84% |
| **5012, IIOT, DH, [BS,RSU], 100MHz, RTT, Absolute** | 0.037 | 0.052 | 0.071 | 0.097 | Yes | Yes |
| Note: Location error of all UEs in the factory is shown. | | | | | | |

Table B.1.2.2.3-2: Sidelink positioning - horizontal relative accuracy for IIoT use cases from [19]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| **5101, IIOT, SH, [UE], 20MHz, RTT+AOA, Relative** | 0.813 | 1.351 | 1.902 | 2.555 | 56% | 8% |
| **5102, IIOT, SH, [UE], 40MHz, RTT+AOA, Relative** | 0.469 | 0.713 | 1.018 | 1.489 | 79% | 23% |
| **5103, IIOT, SH, [UE], 100MHz, RTT+AOA, Relative** | 0.136 | 0.215 | 0.358 | 0.899 | Yes | 64% |
| **5104, IIOT, SH, [RSU,UE], 20MHz, RTT+AOA, Relative** | 0.812 | 1.224 | 1.753 | 2.429 | 59% | 9% |
| **5105, IIOT, SH, [RSU,UE], 40MHz, RTT+AOA, Relative** | 0.352 | 0.532 | 0.722 | 1.022 | 89% | 26% |
| **5106, IIOT, SH, [RSU,UE], 100MHz, RTT+AOA, Relative** | 0.077 | 0.123 | 0.185 | 0.304 | Yes | 81% |
| **5107, IIOT, DH, [UE], 20MHz, RTT+AOA, Relative** | 0.856 | 1.381 | 1.923 | 2.596 | 57% | 7% |
| **5108, IIOT, DH, [UE], 40MHz, RTT+AOA, Relative** | 0.456 | 0.672 | 0.995 | 1.620 | 80% | 25% |
| **5109, IIOT, DH, [UE], 100MHz, RTT+AOA, Relative** | 0.121 | 0.196 | 0.334 | 0.844 | Yes | 67% |
| **5110, IIOT, DH, [RSU,UE], 20MHz, RTT+AOA, Relative** | 0.907 | 1.425 | 1.972 | 2.573 | 53% | 6% |
| **5111, IIOT, DH, [RSU,UE], 40MHz, RTT+AOA, Relative** | 0.396 | 0.590 | 0.787 | 1.095 | 89% | 25% |
| **5112, IIOT, DH, [RSU,UE], 100MHz, RTT+AOA, Relative** | 0.075 | 0.116 | 0.172 | 0.271 | Yes | 83% |
| Note: Location error of all UEs in the factory is shown. | | | | | | |

#### B.1.2.2.4 Positioning accuracy evaluation results for Sidelink Positioning for Public Safety

Table B.1.2.2.4-1 provides horizontal absolute positioning accuracy results using sidelink positioning for public safety use cases.

Table B.1.2.2.4-2 provides horizontal relative positioning accuracy results using sidelink positioning for public safety use cases.

Table B.1.2.2.4-3 provides ranging distance accuracy results using sidelink positioning for public safety use cases.

Table B.1.2.2.4-4 provides ranging angle accuracy results using sidelink positioning for public safety use cases.

Table B.1.2.2.4-1: Sidelink positioning - horizontal absolute accuracy for public safety use cases from [19]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the target requirement** |
| **3001, PS, [RSU], 10MHz, RTT, Absolute** | 9.402 | 21.234 | 40.737 | 58.496 | 3% |
| **3002, PS, [RSU], 20MHz, RTT, Absolute** | 4.258 | 12.351 | 26.327 | 40.256 | 15% |
| **3003, PS, [RSU], 40MHz, RTT, Absolute** | 1.619 | 3.869 | 11.990 | 22.276 | 35% |
| **3004, PS, [RSU], 100MHz, RTT, Absolute** | 0.341 | 0.582 | 1.326 | 7.742 | 76% |
| **3005, PS, [BS,RSU], 10MHz, RTT, Absolute** | 10.748 | 14.816 | 17.752 | 23.886 | 3% |
| **3006, PS, [BS,RSU], 20MHz, RTT, Absolute** | 10.832 | 14.823 | 17.791 | 23.986 | 3% |
| **3007, PS, [BS,RSU], 40MHz, RTT, Absolute** | 1.795 | 5.477 | 12.564 | 23.298 | 32% |
| **3008, PS, [BS,RSU], 100MHz, RTT, Absolute** | 0.334 | 0.558 | 1.163 | 7.555 | 78% |

Table B.1.2.2.4-2: Sidelink positioning - horizontal relative accuracy for public safety use cases from [19]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the target requirement** |
| **3101, PS, [UE], 10MHz, RTT+AOA, Relative** | 2.205 | 3.649 | 4.899 | 6.977 | 28% |
| **3102, PS, [UE], 20MHz, RTT+AOA, Relative** | 0.699 | 1.098 | 1.628 | 2.351 | 63% |
| **3103, PS, [UE], 40MHz, RTT+AOA, Relative** | 0.405 | 0.601 | 0.878 | 1.423 | 83% |
| **3104, PS, [UE], 100MHz, RTT+AOA, Relative** | 0.176 | 0.295 | 0.497 | 0.956 | Yes |
| **3105, PS, [UE,RSU], 10MHz, RTT+AOA, Relative** | 2.193 | 3.626 | 4.838 | 6.983 | 28% |
| **3106, PS, [UE,RSU], 20MHz, RTT+AOA, Relative** | 0.703 | 1.106 | 1.622 | 2.341 | 63% |
| **3107, PS, [UE,RSU], 40MHz, RTT+AOA, Relative** | 0.420 | 0.617 | 0.887 | 1.454 | 82% |
| **3108, PS, [UE,RSU], 100MHz, RTT+AOA, Relative** | 0.208 | 0.332 | 0.544 | 0.971 | Yes |

Table B.1.2.2.4-3: Sidelink positioning - ranging distance accuracy for public safety use cases from [19]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the target requirement** |
| **3101, PS, [UE], 10MHz, RTT+AOA, Relative** | 1.878 | 3.326 | 4.384 | 5.567 | 35% |
| **3102, PS, [UE], 20MHz, RTT+AOA, Relative** | 0.463 | 0.775 | 1.217 | 1.830 | 74% |
| **3103, PS, [UE], 40MHz, RTT+AOA, Relative** | 0.224 | 0.375 | 0.528 | 0.805 | Yes |
| **3104, PS, [UE], 100MHz, RTT+AOA, Relative** | 0.049 | 0.085 | 0.130 | 0.215 | Yes |
| **3105, PS, [UE,RSU], 10MHz, RTT+AOA, Relative** | 1.870 | 3.288 | 4.343 | 5.522 | 34% |
| **3106, PS, [UE,RSU], 20MHz, RTT+AOA, Relative** | 0.473 | 0.784 | 1.222 | 1.803 | 73% |
| **3107, PS, [UE,RSU], 40MHz, RTT+AOA, Relative** | 0.232 | 0.396 | 0.561 | 0.869 | Yes |
| **3108, PS, [UE,RSU], 100MHz, RTT+AOA, Relative** | 0.072 | 0.122 | 0.191 | 0.330 | Yes |

Table B.1.2.2.4-4: Sidelink positioning - ranging angle accuracy for public safety use cases from [19]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| **3101, PS, [UE], 10MHz, RTT+AOA, Relative** | 1.521 | 2.672 | 4.589 | 8.356 | Yes | 89% |
| **3102, PS, [UE], 20MHz, RTT+AOA, Relative** | 1.239 | 2.135 | 3.432 | 6.293 | Yes | Yes |
| **3103, PS, [UE], 40MHz, RTT+AOA, Relative** | 1.047 | 1.810 | 2.791 | 4.942 | Yes | Yes |
| **3104, PS, [UE], 100MHz, RTT+AOA, Relative** | 0.832 | 1.402 | 2.245 | 3.785 | Yes | Yes |
| **3105, PS, [UE,RSU], 10MHz, RTT+AOA, Relative** | 1.530 | 2.633 | 4.410 | 7.983 | Yes | Yes |
| **3106, PS, [UE,RSU], 20MHz, RTT+AOA, Relative** | 1.245 | 2.111 | 3.383 | 5.994 | Yes | Yes |
| **3107, PS, [UE,RSU], 40MHz, RTT+AOA, Relative** | 1.048 | 1.779 | 2.764 | 4.771 | Yes | Yes |
| **3108, PS, [UE,RSU], 100MHz, RTT+AOA, Relative** | 0.832 | 1.405 | 2.240 | 3.642 | Yes | Yes |

#### B.1.2.2.5 Positioning accuracy evaluation results for Sidelink Positioning for Commercial use cases

Table B.1.2.2.5-1 provides horizontal absolute positioning accuracy results using sidelink positioning for commercial use cases.

Table B.1.2.2.5-2 provides horizontal relative positioning accuracy results using sidelink positioning for commercial use cases.

Table B.1.2.2.5-3 provides ranging distance accuracy results using sidelink positioning for commercial use cases.

Table B.1.2.2.5-4 provides ranging angle accuracy results using sidelink positioning for commercial use cases.

Table B.1.2.2.5-1: Sidelink positioning - horizontal absolute accuracy for commercial use cases from [19]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the target requirement** |
| **4001, Commercial, [RSU,UE], 20MHz, RTT, Absolute** | 0.520 | 0.753 | 1.015 | 1.595 | 79% |
| **4002, Commercial, [RSU,UE], 40MHz, RTT, Absolute** | 0.257 | 0.342 | 0.451 | 0.584 | Yes |
| **4003, Commercial, [RSU,UE], 100MHz, RTT, Absolute** | 0.051 | 0.075 | 0.103 | 0.147 | Yes |

Table B.1.2.2.5-2: Sidelink positioning - horizontal relative accuracy for commercial use cases from [19]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the target requirement** |
| **4101, Commercial, [UE], 20MHz, RTT+AOA, Relative** | 0.592 | 0.847 | 1.384 | 2.885 | 72% |
| **4102, Commercial, [UE], 40MHz, RTT+AOA, Relative** | 0.386 | 0.618 | 0.953 | 1.821 | 81% |
| **4103, Commercial, [UE], 100MHz, RTT+AOA, Relative** | 0.104 | 0.171 | 0.278 | 0.534 | Yes |
| **4104, Commercial, [UE,RSU], 20MHz, RTT+AOA, Relative** | 0.505 | 0.745 | 1.064 | 1.756 | 77% |
| **4105, Commercial, [UE,RSU], 40MHz, RTT+AOA, Relative** | 0.331 | 0.448 | 0.585 | 0.775 | Yes |
| **4106, Commercial, [UE,RSU], 100MHz,RTT+AOA, Relative** | 0.067 | 0.091 | 0.122 | 0.174 | Yes |

Table B.1.2.2.5-3: Sidelink positioning - ranging distance accuracy for commercial use cases from [19]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the target requirement** |
| **4101, Commercial, [UE], 20MHz, RTT+AOA, Relative** | 0.466 | 0.639 | 0.934 | 1.627 | 81% |
| **4102, Commercial, [UE], 40MHz, RTT+AOA, Relative** | 0.248 | 0.444 | 0.640 | 1.046 | 88% |
| **4103, Commercial, [UE], 100MHz, RTT+AOA, Relative** | 0.043 | 0.060 | 0.084 | 0.130 | Yes |
| **4104, Commercial, [UE,RSU], 20MHz, RTT+AOA, Relative** | 0.406 | 0.606 | 0.878 | 1.448 | 83% |
| **4105, Commercial, [UE,RSU], 40MHz, RTT+AOA, Relative** | 0.174 | 0.266 | 0.384 | 0.544 | Yes |
| **4106, Commercial, [UE,RSU], 100MHz, RTT+AOA, Relative** | 0.033 | 0.050 | 0.069 | 0.097 | Yes |

Table B.1.2.2.5-4: Sidelink positioning - ranging angle accuracy for commercial use cases from [19]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| **4101, Commercial, [UE], 20MHz, RTT+AOA, Relative** | 1.330 | 2.453 | 4.373 | 9.267 | Yes | 88% |
| **4102, Commercial, [UE], 40MHz, RTT+AOA, Relative** | 1.056 | 1.898 | 3.353 | 6.771 | Yes | Yes |
| **4103, Commercial, [UE], 100MHz, RTT+AOA, Relative** | 0.716 | 1.266 | 2.242 | 4.452 | Yes | Yes |
| **4104, Commercial, [UE,RSU], 20MHz, RTT+AOA, Relative** | 1.316 | 2.414 | 4.223 | 8.281 | Yes | 89% |
| **4105, Commercial, [UE,RSU], 40MHz, RTT+AOA, Relative** | 1.852 | 2.819 | 4.157 | 6.117 | Yes | Yes |
| **4106, Commercial, [UE,RSU], 100MHz, RTT+AOA, Relative** | 0.426 | 0.653 | 1.004 | 1.485 | Yes | Yes |

## B.1.3 Results from source [20]

### B.1.3.1 Description of evaluation scenarios

Common assumptions applicable to all evaluated scenarios in Table B.1.3.1-1.

Evaluation cases and relevant additional assumptions for highway scenario in V2X use case are provided in Table B.1.3.1-2.

Evaluation cases and relevant additional assumptions for urban grid scenario in V2X use cases are provided in Table B.1.3.1-3.

Evaluation cases and relevant additional assumptions for IIOT use cases are provided in Table B.1.3.1-4.

Table B.1.3.1-1: Common assumptions for sidelink positioning evaluations

|  |  |
| --- | --- |
| Parameter |  |
| Subcarrier spacing | 30kHz |
| Reference Signal Transmission Bandwidth | 10 MHz/20MHz/40MHz/100MHz |
| Number of symbols used per occasion | 1 |
| Number of occasions used per positioning estimate | 1 |
| Interference modelling (ideal muting, or other) | Ideal muting |
| Description of Measurement Algorithm (e.g. super resolution, interference cancellation, ….) | super resolution |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | Taylor series |
| Network synchronization assumptions | Perfect sync/Max sync error is 50ns |
| UE/gNB/RSU RX and TX timing error assumption | Ideal muting |
| Uplink power control (applied/not applied) | Not applied |

Table B.1.3.1-2: Additional assumptions for highway scenario in V2X use case

|  |  |
| --- | --- |
| Parameter |  |
| Carrier frequency | 6GHz |
| RSU deployment | Option1: 200m spacing on both sides of highway symmetrically  Option2: Staggered on both sides of highway with distance of 200m |
| Number of RSUs for absolute positioning | 5 or 10 |
| UE or UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1)  dH=dV=0.5λ |
| X for relative or ranging positioning | {25 50 100}m |
| Link type for positioning | Absolute positioning: UE to RSU  Relative positioning: UE to UE  Ranging: UE to UE and UE to RSU |
| Positioning method | RTT for absolute positioning and ranging distance  RTT+AOA for relative positioning and ranging angle |

Table B.1.3.1-3: Additional assumptions for urban grid scenario in V2X use case

|  |  |
| --- | --- |
| Parameter |  |
| Carrier frequency | 6GHz |
| RSU deployment | RSU is deployed in the intersection of the street |
| Number of RSUs for absolute positioning | 5 or 10 |
| UE or UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1)  dH=dV=0.5λ |
| X for relative or ranging positioning | {25 50 100}m for ranging distance  {10 25 50}m for relative positioning and ranging angle |
| Link type for positioning | Absolute positioning: UE to RSU  Relative positioning: UE to UE  Ranging: UE to UE and UE to RSU |
| Positioning method | RTT for absolute positioning and ranging distance  RTT+AOA for relative positioning and ranging angle |
| Network synchronization assumptions | Perfect sync/Max sync error is 50ns |

Table B.1.3.1-4: Additional assumptions for urban grid scenario in IIOT use case

|  |  |
| --- | --- |
| Parameter |  |
| Carrier frequency | 3.5GHz |
| RSU deployment | BS is replaced by RSU |
| Number of RSUs for absolute positioning | 5 |
| UE antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1)  dH=dV=0.5λ |
| UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (4, 4, 2, 1, 1)  dH=dV=0.5λ |
| X for relative or ranging positioning | 10m |
| Link type for positioning | Absolute positioning: UE to RSU  Relative positioning: UE to UE  Ranging: UE to UE and UE to RSU |
| Positioning method | RTT for absolute positioning and ranging distance  RTT+AOA for relative positioning and ranging angle |

### B.1.3.2 Positioning accuracy evaluation results for Sidelink Positioning

#### B.1.3.2.1 Positioning accuracy evaluation results for Sidelink Positioning for Highway Scenarios for V2X

Table B.1.3.2.1-1 provides horizontal absolute positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.3.2.1-2 provides horizontal relative positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.3.2.1-3 provides ranging distance accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.3.2.1-4 provides ranging angle accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.3.2.1-1: Sidelink positioning - horizontal absolute accuracy for highway scenario

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1 Highway 10M  5 staggered RSU | 1.03 | 1.432 | 2.05 | 2.92 | No | No |
| Case 2 Highway 20M  5 staggered RSU | 0.612 | 0.939 | 1.426 | 2.46 | No | No |
| Case 3 Highway 40M  5 staggered RSU | 0.575 | 0.89 | 1.247 | 1.83 | No | No |
| Case 4 Highway 100M  5 staggered RSU | 0.375 | 0.592 | 0.845 | 1.51 | No | No |
| Case 5 Highway 10M  10 staggered RSU | 0.916 | 1.43 | 2.23 | 3.55 | No | No |
| Case 6 Highway 20M  10 staggered RSU | 0.739 | 1.04 | 1.423 | 2.23 | No | No |
| Case 7 Highway 40M  10 staggered RSU | 0.569 | 0.892 | 1.316 | 2.01 | No | No |
| Case 8 Highway 100M  10 staggered RSU | 0.482 | 0.686 | 0.99 | 1.41 | Yes | No |
| Case 9 Highway 10M  5 symmetric RSU | 0.86 | 1.41 | 2.1 | 3.02 | No | No |
| Case 10 Highway 20M  5 symmetric RSU | 0.65 | 1.04 | 1.65 | 2.56 | No | No |
| Case 11 Highway 40M  5 symmetric RSU | 0.48 | 0.84 | 1.34 | 1.78 | No | No |
| Case 12 Highway 100M  5 symmetric RSU | 0.35 | 0.58 | 0.81 | 1.32 | Yes | No |
| Case 13 Highway 10M  10 symmetric RSU | 1.12 | 1.76 | 2.58 | 4.03 | No | No |
| Case 14 Highway 20M  10 symmetric RSU | 0.87 | 1.43 | 2.32 | 3.27 | No | No |
| Case 15 Highway 40M  10 symmetric RSU | 0.77 | 1.12 | 1.63 | 2.58 | No | No |
| Case 16 Highway 100M  10 symmetric RSU | 0.69 | 0.98 | 1.43 | 2.08 | No | No |

Table B.1.3.2.1-2: Sidelink positioning - horizontal relative accuracy for highway scenario

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case1 Highway 10M V2V link X=25 | 1.36 | 1.79 | 2.42 | 3.59 | No | No |
| Case 2 Highway 20M V2V link X=25 | 0.84 | 1.31 | 1.99 | 2.81 | No | No |
| Case 3 Highway 40M V2V link X=25 | 0.59 | 0.96 | 1.39 | 2.22 | No | No |
| Case 4 Highway 100M V2V link X=25 | 0.35 | 0.62 | 1.02 | 1.71 | No | No |
| Case 5 Highway 10M V2V link X=50 | 1.69 | 2.58 | 3.81 | 5.76 | No | No |
| Case 6 Highway 20M V2V link X=50 | 1.23 | 2.05 | 3.01 | 4.47 | No | No |
| Case 7 Highway 40M V2V link X=50 | 0.91 | 1.46 | 2.46 | 3.77 | No | No |
| Case 8 Highway 100M V2V link X=50 | 0.54 | 0.96 | 1.57 | 2.65 | No | No |
| Case 9 Highway 10M V2V link X=100 | 2.62 | 4.3 | 7.08 | 11.44 | No | No |
| Case 10 Highway 20M V2V link X=100 | 2.01 | 3.43 | 5.64 | 9.68 | No | No |
| Case 11 Highway 40M V2V link X=100 | 1.57 | 2.88 | 4.75 | 7.87 | No | No |
| Case 12 Highway 100M V2V link X=100 | 0.96 | 1.85 | 3.33 | 5.74 | No | No |

Table B.1.3.2.1-3: Sidelink positioning - horizontal ranging distance accuracy for highway scenario

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1 Highway 10M V2V link X=25 | 0.94 | 1.09 | 1.2 | 1.312 | Yes | No |
| Case 2 Highway 20M V2V link X=25 | 0.457 | 0.55 | 0.614 | 0.669 | Yes | No |
| Case 3 Highway 40M V2V link X=25 | 0.23 | 0.275 | 0.315 | 0.347 | Yes | Yes |
| Case 4 Highway 100M V2V link X=25 | 0.12 | 0.144 | 0.162 | 0.18 | Yes | Yes |
| Case 5 Highway 10M V2V link X=50 | 0.89 | 1.07 | 1.19 | 1.305 | Yes | No |
| Case 6 Highway 20M V2V link X=50 | 0.455 | 0.546 | 0.617 | 0.674 | Yes | No |
| Case 7 Highway 40M V2V link X=50 | 0.232 | 0.279 | 0.316 | 0.351 | Yes | Yes |
| Case 8 Highway 100M V2V link X=50 | 0.12 | 0.144 | 0.162 | 0.183 | Yes | Yes |
| Case 9 Highway 10M V2V link X=100 | 0.89 | 1.06 | 1.19 | 1.305 | Yes | No |
| Case 10 Highway 20M V2V link X=100 | 0.458 | 0.551 | 0.62 | 0.685 | Yes | No |
| Case 11 Highway 40M V2V link X=100 | 0.234 | 0.281 | 0.319 | 0.359 | Yes | Yes |
| Case 12 Highway 100M V2V link X=100 | 0.12 | 0.144 | 0.166 | 0.19 | Yes | Yes |
| Case 13 Highway 10M V2R link staggered RSU X=25 | 0.79 | 1.03 | 1.167 | 1.31 | Yes | No |
| Case 14 Highway 20M V2R link staggered RSU X=25 | 0.47 | 0.552 | 0.668 | 0.733 | Yes | No |
| Case 15 Highway 40M V2R link staggered RSU X=25 | 0.246 | 0.309 | 0.402 | 0.491 | Yes | Yes |
| Case 16 Highway 100M V2R link staggered RSU X=25 | 0.119 | 0.16 | 0.191 | 0.457 | Yes | Yes |
| Case 17 Highway 10M V2R link staggered RSU X=50 | 0.835 | 1.04 | 1.167 | 1.32 | Yes | No |
| Case 18 Highway 20M V2R link staggered RSU X=50 | 0.434 | 0.545 | 0.631 | 0.733 | Yes | No |
| Case 19 Highway 40M V2R link staggered RSU X=50 | 0.226 | 0.296 | 0.358 | 0.442 | Yes | Yes |
| Case 20 Highway 100M V2R link staggered RSU X=50 | 0.12 | 0.16 | 0.215 | 0.372 | Yes | Yes |
| Case 21 Highway 10M V2R link staggered RSU X=100 | 0.835 | 1.01 | 1.167 | 1.34 | Yes | No |
| Case 22 Highway 20M V2R link staggered RSU X=100 | 0.436 | 0.54 | 0.639 | 0.745 | Yes | No |
| Case 23 Highway 40M V2R link staggered RSU X=100 | 0.226 | 0.3 | 0.377 | 0.492 | Yes | Yes |
| Case 24 Highway 100M V2R link staggered RSU X=100 | 0.12 | 0.179 | 0.245 | 0.421 | Yes | Yes |
| Case 25 Highway 10M V2R link symmetric RSU X=25 | 0.81 | 0.99 | 1.16 | 1.33 | Yes | No |
| Case 26 Highway 20M V2R link symmetric RSU X=25 | 0.5 | 0.58 | 0.66 | 1.02 | Yes | No |
| Case 27 Highway 40M V2R link symmetric RSU X=25 | 0.25 | 0.31 | 0.34 | 0.48 | Yes | Yes |
| Case 28 Highway 100M V2R link symmetric RSU X=25 | 0.13 | 0.16 | 0.21 | 0.28 | Yes | Yes |
| Case 29 Highway 10M V2R link symmetric RSU X=50 | 0.82 | 1.01 | 1.21 | 1.35 | Yes | No |
| Case 30 Highway 20M V2R link symmetric RSU X=50 | 0.44 | 0.53 | 0.64 | 0.78 | Yes | No |
| Case 31 Highway 40M V2R link symmetric RSU X=50 | 0.24 | 0.29 | 0.34 | 0.43 | Yes | Yes |
| Case 32 Highway 100M V2R link symmetric RSU X=50 | 0.13 | 0.17 | 0.22 | 0.31 | Yes | Yes |
| Case 33 Highway 10M V2R link symmetric RSU X=100 | 0.8 | 1.03 | 1.22 | 1.39 | Yes | No |
| Case 34 Highway 20M V2R link symmetric RSU X=100 | 0.42 | 0.55 | 0.66 | 0.8 | Yes | No |
| Case 35 Highway 40M V2R link symmetric RSU X=100 | 0.25 | 0.3 | 0.37 | 0.49 | Yes | Yes |
| Case 36 Highway 100M V2R link symmetric RSU X=100 | 0.13 | 0.17 | 0.24 | 0.38 | Yes | Yes |

Table B.1.3.2.1-4: Sidelink positioning - horizontal ranging angle accuracy for highway scenario

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1 Highway 10M V2V link X=50 | 3.49 | 5.48 | 8.04 | 11.64 | Yes | No |
| Case 2 Highway 20M V2V link X=50 | 2.67 | 4.23 | 6.38 | 9.66 | Yes | No |
| Case 3 Highway 40M V2V link X=50 | 2.13 | 3.41 | 5.32 | 7.84 | Yes | Yes |
| Case 4 Highway 100M V2V link X=50 | 1.25 | 2.3 | 3.63 | 5.78 | Yes | Yes |
| Case 5 Highway 10M V2V link X=100 | 3.33 | 5.45 | 8.08 | 11.56 | Yes | No |
| Case 6 Highway 20M V2V link X=100 | 2.66 | 4.39 | 6.67 | 10.08 | Yes | No |
| Case 7 Highway 40M V2V link X=100 | 2.12 | 3.53 | 5.4 | 7.91 | Yes | Yes |
| Case 8 Highway 100M V2V link X=100 | 1.31 | 2.37 | 3.89 | 6.03 | Yes | Yes |

#### B.1.3.2.2 Positioning accuracy evaluation results for Sidelink Positioning for Urban Grid Scenarios for V2X

Table B.1.3.2.2-1 provides horizontal absolute positioning accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.3.2.2-2 provides horizontal relative positioning accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.3.2.2-3 provides ranging distance accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.3.2.2-4 provides ranging angle accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.3.2.2-1: Sidelink positioning - horizontal absolute accuracy for urban grid scenario

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1 Urban 10M 5RSU | 5 | 7.48 | 11.01 | 20.32 | No | No |
| Case 2 Urban 20M 5RSU | 4.11 | 6.05 | 8.64 | 15.81 | No | No |
| Case 3 Urban 40M 5RSU | 3.22 | 4.18 | 5.58 | 8.85 | No | No |
| Case 4 Urban 100M 5RSU | 2.67 | 3.48 | 4.91 | 7.53 | No | No |
| Case 5 Urban 10M 10RSU | 4.31 | 5.58 | 7.32 | 9.93 | No | No |
| Case 6 Urban 20M 10RSU | 3.25 | 4.16 | 5.22 | 7.03 | No | No |
| Case 7 Urban 40M 10RSU | 2.53 | 3.16 | 3.93 | 5.13 | No | No |
| Case 8 Urban 100M 10RSU | 2.17 | 2.68 | 3.31 | 4.18 | No | No |
| Case 9 Urban 10M 5RSU with LOS link only | 4.85 | 7.59 | 10.58 | 20.23 | No | No |
| Case 10 Urban 20M 5RSU with LOS link only | 4.14 | 6.14 | 8.31 | 15.62 | No | No |
| Case 11 Urban 40M 5RSU with LOS link only | 2.96 | 4.03 | 5.62 | 8.63 | No | No |
| Case 12 Urban 100M 5RSU with LOS link only | 2.68 | 3.55 | 4.8 | 7.43 | No | No |
| Case 13 Urban 10M 10RSU with LOS link only | 4.37 | 5.66 | 7.58 | 9.89 | No | No |
| Case 14 Urban 20M 10RSU with LOS link only | 3.23 | 4.09 | 5.18 | 6.99 | No | No |
| Case 15 Urban 40M 10RSU with LOS link only | 2.5 | 3.16 | 3.96 | 5.12 | No | No |
| Case 16 Urban 100M 10RSU with LOS link only | 2.14 | 2.63 | 3.24 | 4.13 | No | No |
| Case 17 Urban 20M 5RSU with sync error | 9.13 | 11.93 | 15.67 | 22.65 | No | No |
| Case 18 Urban 20M 10RSU with sync error | 6.29 | 7.87 | 9.44 | 11.18 | No | No |

Table B.1.3.2.2-2: Sidelink positioning - horizontal relative accuracy for urban grid scenario

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1 Urban 10M V2V link X=10 | 1.36 | 1.73 | 2.37 | 3.72 | No | No |
| Case 2 Urban 20M V2V link X=10 | 0.8 | 1.07 | 1.67 | 3.27 | No | No |
| Case 3 Urban 40M V2V link X=10 | 0.49 | 0.77 | 1.39 | 3.08 | No | No |
| Case 4 Urban 100M V2V link X=10 | 0.3 | 0.53 | 1.05 | 2.92 | No | No |
| Case 5 Urban 10M V2V link X=25 | 2.35 | 3.95 | 6.36 | 10.52 | No | No |
| Case 6 Urban 20M V2V link X=25 | 1.81 | 3.41 | 5.95 | 9.88 | No | No |
| Case 7 Urban 40M V2V link X=25 | 1.3 | 2.68 | 5.02 | 8.9 | No | No |
| Case 8 Urban 100M V2V link X=25 | 0.86 | 1.99 | 3.76 | 7.89 | No | No |
| Case 9 Urban 10M V2V link X=50 | 5.22 | 9.63 | 16.08 | 25.34 | No | No |
| Case 10 Urban 20M V2V link X=50 | 4.22 | 8.19 | 14.19 | 23.61 | No | No |
| Case 11 Urban 40M V2V link X=50 | 3.26 | 7.03 | 12.2 | 21.96 | No | No |
| Case 12 Urban 100M V2V link X=50 | 2.27 | 5.37 | 10.61 | 20.82 | No | No |
| Case 13 Urban 10M V2V link X=10 with LOS link only | 1.24 | 1.53 | 1.88 | 2.34 | No | No |
| Case 14 Urban 20M V2V link X=10 with LOS link only | 0.72 | 0.9 | 1.14 | 1.52 | No | No |
| Case 15 Urban 40M V2V link X=10 with LOS link only | 0.43 | 0.56 | 0.78 | 1.21 | Yes | No |
| Case 16 Urban 100M V2V link X=10 with LOS link only | 0.25 | 0.37 | 0.53 | 0.83 | Yes | No |
| Case 17 Urban 10M V2V link X=25 with LOS link only | 1.87 | 2.75 | 4.27 | 6.26 | No | No |
| Case 18 Urban 20M V2V link X=25 with LOS link only | 1.32 | 2.2 | 3.57 | 5.45 | No | No |
| Case 19 Urban 40M V2V link X=25 with LOS link only | 0.87 | 1.56 | 2.56 | 4.08 | No | No |
| Case 20 Urban 100M V2V link X=25 with LOS link only | 0.55 | 1.06 | 1.87 | 3.06 | No | No |
| Case 21 Urban 10M V2V link X=50 with LOS link only | 2.88 | 5.23 | 8.44 | 13.46 | No | No |
| Case 22 Urban 20M V2V link X=50 with LOS link only | 2.35 | 4.18 | 6.67 | 10.74 | No | No |
| Case 23 Urban 40M V2V link X=50 with LOS link only | 1.66 | 3.15 | 5.47 | 8.79 | No | No |
| Case 24 Urban 100M V2V link X=50 with LOS link only | 1.04 | 2.06 | 3.67 | 6.29 | No | No |

Table B.1.3.2.2-3: Sidelink positioning - horizontal ranging distance accuracy for urban grid scenario

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1 Urban 10M V2V link X=25 | 0.947 | 1.16 | 1.33 | 1.74 | No | No |
| Case 2 Urban 20M V2V link X=25 | 0.487 | 0.629 | 0.787 | 1.38 | Yes | No |
| Case 3 Urban 40M V2V link X=25 | 0.255 | 0.346 | 0.481 | 1.12 | Yes | No |
| Case 4 Urban 100M V2V link X=25 | 0.124 | 0.172 | 0.25 | 0.91 | Yes | No |
| Case 5 Urban 10M V2V link X=50 | 0.972 | 1.214 | 1.47 | 2.53 | No | No |
| Case 6 Urban 20M V2V link X=50 | 0.526 | 0.695 | 1.01 | 2.33 | No | No |
| Case 7 Urban 40M V2V link X=50 | 0.279 | 0.413 | 0.723 | 2.12 | No | No |
| Case 8 Urban 100M V2V link X=50 | 0.137 | 0.209 | 0.675 | 1.94 | No | No |
| Case 9 Urban 10M V2V link X=100 | 1.05 | 1.37 | 2.13 | 4.66 | No | No |
| Case 10 Urban 20M V2V link X=100 | 0.605 | 0.916 | 1.96 | 4.25 | No | No |
| Case 11 Urban 40M V2V link X=100 | 0.353 | 0.679 | 1.79 | 3.62 | No | No |
| Case 12 Urban 100M V2V link X=100 | 0.176 | 0.654 | 1.81 | 3.25 | No | No |
| Case 13 Urban 10M V2V link X=25 with LOS link only | 0.92 | 1.11 | 1.23 | 1.35 | Yes | No |
| Case 14 Urban 20M V2V link X=25 with LOS link only | 0.45 | 0.57 | 0.66 | 0.76 | Yes | No |
| Case 15 Urban 40M V2V link X=25 with LOS link only | 0.21 | 0.28 | 0.35 | 0.44 | Yes | Yes |
| Case 16 Urban 100M V2V link X=25 with LOS link only | 0.1 | 0.13 | 0.16 | 0.2 | Yes | Yes |
| Case 17 Urban 10M V2V link X=50 with LOS link only | 0.92 | 1.11 | 1.24 | 1.39 | Yes | No |
| Case 18 Urban 20M V2V link X=50 with LOS link only | 0.45 | 0.57 | 0.66 | 0.78 | Yes | No |
| Case 19 Urban 40M V2V link X=50 with LOS link only | 0.22 | 0.28 | 0.35 | 0.45 | Yes | Yes |
| Case 20 Urban 100M V2V link X=50 with LOS link only | 0.1 | 0.13 | 0.17 | 0.21 | Yes | Yes |
| Case 21 Urban 10M V2V link X=100 with LOS link only | 0.92 | 1.1 | 1.24 | 1.42 | Yes | No |
| Case 22 Urban 20M V2V link X=100 with LOS link only | 0.45 | 0.57 | 0.67 | 0.81 | Yes | No |
| Case 23 Urban 40M V2V link X=100 with LOS link only | 0.22 | 0.29 | 0.36 | 0.46 | Yes | Yes |
| Case 24 Urban 100M V2V link X=100 with LOS link only | 0.1 | 0.14 | 0.17 | 0.21 | Yes | Yes |
| Case 25 Urban 10M V2R link X=25 | 1.01 | 1.44 | 2.51 | 5.02 | No | No |
| Case 26 Urban 20M V2R link X=25 | 0.67 | 1.19 | 2.45 | 4.58 | No | No |
| Case 27 Urban 40M V2R link X=25 | 0.48 | 1.07 | 2.15 | 3.41 | No | No |
| Case 28 Urban 100M V2R link X=25 | 0.42 | 1.18 | 1.88 | 2.76 | No | No |
| Case 29 Urban 10M V2R link X=50 | 1.17 | 1.73 | 2.57 | 5.45 | No | No |
| Case 30 Urban 20M V2R link X=50 | 0.78 | 1.69 | 2.88 | 4.95 | No | No |
| Case 31 Urban 40M V2R link X=50 | 0.68 | 1.49 | 2.57 | 4 | No | No |
| Case 32 Urban 100M V2R link X=50 | 0.61 | 1.46 | 2.31 | 3.28 | No | No |
| Case 33 Urban 10M V2R link X=100 | 1.24 | 2.07 | 3.47 | 6.59 | No | No |
| Case 34 Urban 20M V2R link X=100 | 1.05 | 1.99 | 3.54 | 6.01 | No | No |
| Case 35 Urban 40M V2R link X=100 | 0.99 | 1.99 | 3.24 | 5.01 | No | No |
| Case 36 Urban 100M V2R link X=100 | 1.02 | 1.98 | 2.78 | 4.06 | No | No |
| Case 37 Urban 10M V2R link X=25 with LOS link only | 1.18 | 1.45 | 2.24 | 3.34 | No | No |
| Case 38 Urban 20M V2R link X=25 with LOS link only | 0.44 | 0.86 | 1.75 | 2.56 | No | No |
| Case 39 Urban 40M V2R link X=25 with LOS link only | 0.32 | 0.35 | 1.31 | 2.18 | No | No |
| Case 40 Urban 100M V2R link X=25 with LOS link only | 0.24 | 0.31 | 1.01 | 1.65 | No | No |
| Case 41 Urban 10M V2R link X=50 with LOS link only | 1.45 | 1.93 | 2.71 | 3.82 | No | No |
| Case 42 Urban 20M V2R link X=50 with LOS link only | 0.51 | 0.91 | 1.89 | 3.06 | No | No |
| Case 43 Urban 40M V2R link X=50 with LOS link only | 0.35 | 0.84 | 1.57 | 2.53 | No | No |
| Case 44 Urban 100M V2R link X=50 with LOS link only | 0.13 | 0.67 | 1.28 | 2.01 | No | No |
| Case 45 Urban 10M V2R link X=100 with LOS link only | 1.44 | 2.04 | 3.05 | 5.01 | No | No |
| Case 46 Urban 20M V2R link X=100 with LOS link only | 0.74 | 1.67 | 2.49 | 3.96 | No | No |
| Case 47 Urban 40M V2R link X=100 with LOS link only | 0.35 | 1.34 | 1.93 | 3.34 | No | No |
| Case 48 Urban 100M V2R link X=100 with LOS link only | 0.21 | 1.1 | 1.51 | 2.58 | No | No |

Table B.1.3.2.2-4: Sidelink positioning - horizontal ranging angle accuracy for urban grid scenario

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1 Urban 10M V2V link X=10 | 8 | 12.23 | 18.39 | 27.7 | No | No |
| Case 2 Urban 20M V2V link X=10 | 5.03 | 8.24 | 13.62 | 25.22 | No | No |
| Case 3 Urban 40M V2V link X=10 | 3.29 | 5.65 | 10.88 | 21.11 | No | No |
| Case 4 Urban 100M V2V link X=10 | 2.25 | 4.15 | 8.06 | 20.33 | No | No |
| Case 5 Urban 10M V2V link X=25 | 9.39 | 15 | 23 | 35.06 | No | No |
| Case 6 Urban 20M V2V link X=25 | 7.31 | 13.07 | 20.8 | 33.1 | No | No |
| Case 7 Urban 40M V2V link X=25 | 5.1 | 9.83 | 16.9 | 30.2 | No | No |
| Case 8 Urban 100M V2V link X=25 | 3.47 | 7.21 | 13.73 | 28.51 | No | No |
| Case 9 Urban 10M V2V link X=50 | 11.75 | 19.79 | 29.26 | 43.11 | No | No |
| Case 10 Urban 20M V2V link X=50 | 9.46 | 16.64 | 25.81 | 41.66 | No | No |
| Case 11 Urban 40M V2V link X=50 | 7.26 | 14.08 | 23.15 | 40.13 | No | No |
| Case 12 Urban 100M V2V link X=50 | 5.03 | 10.48 | 20.4 | 39.45 | No | No |
| Case 13 Urban 10M V2V link X=10 with LOS link only | 6.72 | 10.19 | 14.11 | 19.5 | No | No |
| Case 14 Urban 20M V2V link X=10 with LOS link only | 4.09 | 6.3 | 9.04 | 13.55 | Yes | No |
| Case 15 Urban 40M V2V link X=10 with LOS link only | 2.71 | 4.16 | 6.47 | 9.9 | Yes | No |
| Case 16 Urban 100M V2V link X=10 with LOS link only | 1.78 | 2.87 | 4.58 | 7.14 | Yes | Yes |
| Case 17 Urban 10M V2V link X=25 with LOS link only | 7.64 | 11.67 | 17 | 23.8 | No | No |
| Case 18 Urban 20M V2V link X=25 with LOS link only | 5.6 | 9.18 | 13.92 | 19.6 | No | No |
| Case 19 Urban 40M V2V link X=25 with LOS link only | 3.7 | 6.31 | 10.19 | 15.43 | No | No |
| Case 20 Urban 100M V2V link X=25 with LOS link only | 2.46 | 4.42 | 7.28 | 11.7 | Yes | No |
| Case 21 Urban 10M V2V link X=50 with LOS link only | 8.49 | 13.4 | 19.23 | 25.74 | No | No |
| Case 22 Urban 20M V2V link X=50 with LOS link only | 6.2 | 10.42 | 15.35 | 21.58 | No | No |
| Case 23 Urban 40M V2V link X=50 with LOS link only | 4.49 | 7.79 | 12.07 | 17.14 | No | No |
| Case 24 Urban 100M V2V link X=50 with LOS link only | 2.88 | 5.13 | 8.55 | 13.2 | Yes | No |

#### B.1.3.2.3 Positioning accuracy evaluation results for Sidelink Positioning for IIoT

Table B.1.3.2.3-1 provides horizontal absolute positioning accuracy results using sidelink positioning for IIoT use cases.

Table B.1.3.2.3-2 provides horizontal relative positioning accuracy results using sidelink positioning for IIoT use cases.

Table B.1.3.2.3-3 provides horizontal ranging distance accuracy results using sidelink positioning for IIoT use cases.

Table B.1.3.2.3-4 provides horizontal ranging angle accuracy results using sidelink positioning for IIoT use cases.

Table B.1.3.2.3-1: Sidelink positioning - horizontal absolute accuracy for IIOT scenarios

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1 SH 10M U2R link | 0.36 | 0.52 | 1.01 | 4.65 | No | No |
| Case 2 SH 20M U2R link | 0.19 | 0.26 | 0.47 | 1.66 | No | No |
| Case 3 SH 40M U2R link | 0.09 | 0.11 | 0.14 | 0.23 | Yes | No |
| Case 4 SH 100M U2R link | 0.04 | 0.05 | 0.06 | 0.08 | Yes | Yes |
| Case 5 DH 10M U2R link | 0.38 | 0.66 | 1.68 | 5.58 | No | No |
| Case 6 DH 20M U2R link | 0.21 | 0.36 | 0.71 | 2.38 | No | No |
| Case 7 DH 40M U2R link | 0.08 | 0.1 | 0.13 | 0.91 | Yes | No |
| Case 8 DH 100M U2R link | 0.04 | 0.05 | 0.07 | 0.11 | Yes | Yes |

Table B.1.3.2.3-2: Sidelink positioning - horizontal relative accuracy for IIOT scenario

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1 SH 10M U2U link X=10 | 1.11 | 1.28 | 1.42 | 1.73 | No | No |
| Case 2 SH 20M U2U link X=10 | 0.58 | 0.67 | 0.79 | 1.06 | No | No |
| Case 3 SH 40M U2U link X=10 | 0.3 | 0.36 | 0.47 | 0.72 | Yes | No |
| Case 4 SH 100M U2U link X=10 | 0.16 | 0.19 | 0.27 | 0.47 | Yes | No |
| Case 5 SH 10M U2U link X=10  LOS only | 1.11 | 1.28 | 1.42 | 1.75 | No | No |
| Case 6 SH 20M U2U link X=10  LOS only | 0.58 | 0.67 | 0.79 | 1.06 | No | No |
| Case 7 SH 40M U2U link X=10  LOS only | 0.3 | 0.35 | 0.47 | 0.72 | Yes | No |
| Case 8 SH 100M U2U link X=10  LOS only | 0.16 | 0.18 | 0.26 | 0.44 | Yes | No |
| Case 9 DH 10M U2U link X=10 | 1.11 | 1.27 | 1.41 | 1.87 | No | No |
| Case 10 DH 20M U2U link X=10 | 0.57 | 0.67 | 0.78 | 1.15 | No | No |
| Case 11 DH 40M U2U link X=10 | 0.3 | 0.35 | 0.44 | 0.75 | Yes | No |
| Case 12 DH 100M U2U link X=10 | 0.16 | 0.19 | 0.28 | 0.52 | Yes | No |
| Case 13 DH 10M U2U link X=10  LOS only | 1.1 | 1.27 | 1.41 | 1.87 | No | No |
| Case 14 DH 20M U2U link X=10  LOS only | 0.57 | 0.67 | 0.78 | 1.15 | No | No |
| Case 15 DH 40M U2U link X=10  LOS only | 0.29 | 0.35 | 0.45 | 0.76 | Yes | No |
| Case 16 DH 100M U2U link X=10  LOS only | 0.15 | 0.18 | 0.25 | 0.46 | Yes | No |

Table B.1.3.2.3-3: Sidelink positioning - horizontal ranging distance accuracy for IIOT scenario

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1 SH 10M U2U link X=10 | 0.99 | 1.16 | 1.29 | 1.41 | No | No |
| Case 2 SH 20M U2U link X=10 | 0.51 | 0.6 | 0.67 | 0.72 | Yes | No |
| Case 3 SH 40M U2U link X=10 | 0.24 | 0.29 | 0.33 | 0.36 | Yes | No |
| Case 4 SH 100M U2U link X=10 | 0.11 | 0.14 | 0.16 | 0.18 | Yes | Yes |
| Case 5 SH 10M U2U link X=10  LOS only | 0.99 | 1.16 | 1.29 | 1.41 | No | No |
| Case 6 SH 20M U2U link X=10  LOS only | 0.5 | 0.6 | 0.67 | 0.72 | Yes | No |
| Case 7 SH 40M U2U link X=10  LOS only | 0.24 | 0.29 | 0.33 | 0.36 | Yes | No |
| Case 8 SH 100M U2U link X=10  LOS only | 0.12 | 0.14 | 0.16 | 0.18 | Yes | Yes |
| Case 9 DH 10M U2U link X=10 | 0.98 | 1.13 | 1.27 | 1.41 | No | No |
| Case 10 DH 20M U2U link X=10 | 0.49 | 0.59 | 0.67 | 0.74 | Yes | No |
| Case 11 DH 40M U2U link X=10 | 0.24 | 0.29 | 0.32 | 0.36 | Yes | No |
| Case 12 DH 100M U2U link X=10 | 0.12 | 0.14 | 0.16 | 0.18 | Yes | Yes |
| Case 13 DH 10M U2U link X=10  LOS only | 0.98 | 1.14 | 1.27 | 1.4 | No | No |
| Case 14 DH 20M U2U link X=10  LOS only | 0.47 | 0.58 | 0.66 | 0.72 | Yes | No |
| Case 15 DH 40M U2U link X=10  LOS only | 0.24 | 0.29 | 0.33 | 0.36 | Yes | No |
| Case 16 DH 100M U2U link X=10  LOS only | 0.12 | 0.14 | 0.16 | 0.18 | Yes | Yes |

Table B.1.3.2.3-4: Sidelink positioning - horizontal ranging angle accuracy for IIOT scenario

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1 SH 10M U2U link X=10 | 1.64 | 3.35 | 6.66 | 10.71 | Yes | No |
| Case 2 SH 20M U2U link X=10 | 1.12 | 2.5 | 4.62 | 7.03 | Yes | Yes |
| Case 3 SH 40M U2U link X=10 | 0.77 | 1.83 | 3.02 | 5.11 | Yes | Yes |
| Case 4 SH 100M U2U link X=10 | 0.57 | 1.17 | 2.01 | 3.74 | Yes | Yes |
| Case 5 SH 10M U2U link X=10  LOS only | 1.64 | 3.34 | 6.65 | 10.71 | Yes | No |
| Case 6 SH 20M U2U link X=10  LOS only | 1.1 | 2.5 | 4.61 | 7 | Yes | Yes |
| Case 7 SH 40M U2U link X=10  LOS only | 0.77 | 1.83 | 3.02 | 5.05 | Yes | Yes |
| Case 8 SH 100M U2U link X=10  LOS only | 0.56 | 1.14 | 1.95 | 3.73 | Yes | Yes |
| Case 9 DH 10M U2U link X=10 | 1.99 | 3.98 | 7.25 | 13.72 | Yes | No |
| Case 10 DH 20M U2U link X=10 | 1.19 | 2.42 | 4.51 | 8.13 | Yes | No |
| Case 11 DH 40M U2U link X=10 | 0.83 | 1.71 | 3.1 | 5.89 | Yes | Yes |
| Case 12 DH 100M U2U link X=10 | 0.51 | 1.09 | 2.23 | 4.05 | Yes | Yes |
| Case 13 DH 10M U2U link X=10  LOS only | 1.99 | 3.98 | 7.25 | 13.69 | Yes | No |
| Case 14 DH 20M U2U link X=10  LOS only | 1.18 | 2.4 | 4.5 | 8.11 | Yes | No |
| Case 15 DH 40M U2U link X=10  LOS only | 0.83 | 1.73 | 3.2 | 5.99 | Yes | Yes |
| Case 16 DH 100M U2U link X=10  LOS only | 0.51 | 1.1 | 2.22 | 4.08 | Yes | Yes |

## B.1.4 Results from source [21]

### B.1.4.1 Description of evaluation scenarios

In line with the evaluation methodology agreed in previous meetings the performance of TDOA based absolute positioning and single-sided RTT based ranging are evaluated in highway, urban and IIoT scenarios. In the TDOA method evaluation, only RSUs are used as anchor nodes assuming all of them are perfectly synchronized. In the evaluation of single-sided RTT, the replied SL PRS is transmitted within 10ms.

Common assumptions applicable to all evaluated scenarios are provided in Table B.1.4.1-1.

Table B.1.4.1-1 Common assumption for all scenarios if they are different from or not specified in Agreements

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| Carrier frequency | 6GHz |
| Subcarrier spacing | 30kHz |
| Reference Signal Transmission Bandwidth | 20/40/100MHz |
| Reference Signal Physical Structure and Resource Allocation (RE pattern) | Comb-2, fully staggered |
| Reference signal including PRS, SRS and SL-PRS  (type of sequence, number of ports, …) | Gold Sequence, 1 port |
| Number of symbols used per occasion | 2 |
| number of occasions used per positioning estimate | 1 |
| Power-boosting level | No boosting |
| Uplink power control (applied/not applied) | Not applied |
| interference modelling (ideal muting, or other) | Not modelled |
| Description of Measurement Algorithm (e.g. super resolution, interference cancellation, ….) | Max likelihood |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | CHAN |
| Synchronization assumptions | Perfect |
| UE/gNB RX and TX timing error assumption | N/A |
| Precoding assumptions (codebook, nr of antenna elements used, etc) | N/A |
| Additional notes, if any | N/A |

Additional assumptions for highway, urban and IIoT scenarios are provided in Table B.1.4.1-2, Table B.1.4.1-3 and Table B.1.4.1-4 respectively.

Table B.1.4.1-2 Assumptions for highway if they are different from or not specified in Agreements

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| UE Antenna model | (1, 2, 2, 1, 1) |
| TRP antenna model | (1, 2, 2, 1, 1) for RSU |
| BS/RSU deployment for absolute positioning | uniformly located with 200m spacing on both sides of highway symmetrically |
| Bandwidth | 20MHz, 40MHz, 100MHz |
| Selected values of X (relative positioning or ranging is performed between two UEs within X m) | 50m,100m,150m |
| Positioning method | Absolute: TDOA  Ranging: Single-sided RTT |

Table B.1.4.1-3 Assumptions for urban if they are different from or not specified in Agreements

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| UE Antenna model | (1, 2, 2, 1, 1) |
| TRP antenna model | (1, 2, 2, 1, 1) for RSU |
| BS/RSU deployment for absolute positioning | Located at intersection |
| Bandwidth | 20MHz, 40MHz, 100MHz |
| Selected values of X (relative positioning or ranging is performed between two UEs within X m) | 50m,100m,150m |
| Positioning method | Absolute: TDOA  Ranging: Single-sided RTT |

Table B.1.4.1-4 Assumptions for IIoT if they are different from or not specified in Agreements

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| UE Antenna model | (1, 2, 2, 1, 1) |
| BS/RSU deployment for absolute positioning | TRPs in InF-SH defined in TR 38.857 is replaced with anchor UEs |
| Bandwidth | 20MHz, 40MHz, 100MHz |
| Selected values of X (relative positioning or ranging is performed between two UEs within X m) | 50m,100m,150m |
| Positioning method | Absolute: TDOA  Ranging: Single-sided RTT |

### B.1.4.2 Positioning accuracy evaluation results for Sidelink Positioning

This subsection provides evaluation results including absolute positioning and distance of ranging in highway, urban and IIoT scenarios.

#### B.1.4.2.1 Positioning accuracy evaluation results for Highway Scenario

Table B.1.4.2.1-1 provides horizontal absolute positioning accuracy results using sidelink positioning for highway scenario.

Table B.1.4.2.1-2 provides distance accuracy of ranging results using sidelink positioning for highway scenario.

Table B.1.4.2.1-1 Simulation results for highway for absolute positioning - horizontal accuracy

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case #1, 20MHz, TDOA, absolute positioning | 1.76m | 2.12m | 3.12m | 4.99m | No | No |
| Case #2, 40MHz, TDOA, absolute positioning | 0.74m | 1.24m | 1.85m | 2.29m | NO | NO |
| Case #3, 100MHz, TDOA, absolute positioning | 0.31m | 0.52m | 0.75m | 1.1m | Yes | NO |

Table B.1.4.2.1-2 Simulation results for highway for ranging - distance accuracy

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 66.7% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case #1, 20MHz, Single-sided RTT, Ranging, X=50 m | 2.29 | 3.152 | 3.818 | 4.342 | No | No |
| Case #2, 40MHz, Single-sided RTT, Ranging, X=50 m | 1.176 | 1.589 | 1.926 | 2.2 | No | No |
| Case #3, 100MHz, Single-sided RTT, Ranging, X=50 m | 0.5955 | 0.8094 | 0.9745 | 1.106 | Yes | No |
| Case #4, 20MHz, Single-sided RTT, Ranging, X=100 m | 2.355 | 3.192 | 3.845 | 4.354 | No | No |
| Case #5, 40MHz, Single-sided RTT, Ranging, X=100 m | 1.221 | 1.622 | 1.947 | 2.2 | No | No |
| Case #6, 100MHz, Single-sided RTT, Ranging, X=100 m | 0.6064 | 0.8146 | 0.9757 | 1.112 | Yes | No |
| Case #7, 20MHz, Single-sided RTT, Ranging, X=150 m | 2.39 | 3.201 | 3.855 | 4.36 | No | No |
| Case #8, 40MHz, Single-sided RTT, Ranging, X=150 m | 1.227 | 1.63 | 1.952 | 2.2 | No | No |
| Case #9, 100MHz, Single-sided RTT, Ranging, X=150 m | 0.6061 | 0.8127 | 0.9731 | 1.109 | Yes | No |

#### B.1.4.2.2 Positioning accuracy evaluation results for Urban Scenario

Table B.1.4.2.2-1 provides horizontal absolute positioning accuracy results using sidelink positioning for urban scenario.

Table B.1.4.2.2-2 provides distance accuracy of ranging results using sidelink positioning for urban scenario.

Table B.1.4.2.2-1 Simulation results for urban for absolute positioning - horizontal accuracy

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case #1, 20MHz, TDOA, absolute positioning | 4.56m | 5.61m | 8.99m | 13.59m | NO | NO |
| Case #2, 40MHz, TDOA, absolute positioning | 3.55m | 5.05m | 6.05m | 9.05m | NO | NO |
| Case #3, 100MHz, TDOA, absolute positioning | 2.56m | 3.99m | 4.93m | 5.66m | NO | NO |

Table B.1.4.2.2-1 Simulation results for Urban for ranging - distance accuracy

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 66.7% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case #1, 20MHz, Single-sided RTT, Ranging, X=50 m | 2.087 | 3.084 | 3.771 | 4.369 | No | No |
| Case #2, 40MHz, Single-sided RTT, Ranging, X=50 m | 1.05 | 1.484 | 1.852 | 2.147 | No | No |
| Case #3, 100MHz, Single-sided RTT, Ranging, X=50 m | 0.5527 | 0.7857 | 0.9567 | 1.093 | Yes | No |
| Case #4, 20MHz, Single-sided RTT, Ranging, X=100 m | 2.256 | 3.148 | 3.851 | 4.4 | No | No |
| Case #5, 40MHz, Single-sided RTT, Ranging, X=100 m | 1.152 | 1.574 | 1.914 | 2.175 | No | No |
| Case #6, 100MHz, Single-sided RTT, Ranging, X=100 m | 0.5768 | 0.7963 | 0.9572 | 1.089 | Yes | No |
| Case #7, 20MHz, Single-sided RTT, Ranging, X=150 m | 2.376 | 3.209 | 3.894 | 4.422 | No | No |
| Case #8, 40MHz, Single-sided RTT, Ranging, X=150 m | 1.212 | 1.624 | 1.949 | 2.197 | No | No |
| Case #9, 100MHz, Single-sided RTT, Ranging, X=150 m | 0.5921 | 0.8025 | 0.9619 | 1.089 | Yes | No |

#### B.1.4.2.3 Positioning accuracy evaluation results for IIoT Scenario

Table B.1.4.2.3-1 provides horizontal absolute positioning accuracy results using sidelink positioning for IIoT scenario.

Table B.1.4.2.3-2 provides distance accuracy of ranging results using sidelink positioning for IIoT scenario.

Table B.1.4.2.3-1 Simulation results for IIoT for absolute positioning - horizontal accuracy

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case #1, 20MHz, TDOA, absolute positioning | 0.98m | 1.33m | 2.05m | 3.49m | NO | NO |
| Case #2, 40MHz, TDOA, absolute positioning | 0.48m | 0.66m | 0.99m | 1.56m | NO | NO |
| Case #3, 100MHz, TDOA, absolute positioning | 0.23m | 0.33m | 0.50m | 0.87m | Yes | NO |

Table B.1.4.2.3-2 Simulation results for IIoT for ranging - distance accuracy

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 66.7% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case #1, 20MHz, Single-sided RTT, Ranging, X=50 m | 20M | 2.337 | 3.193 | 3.87 | No | No |
| Case #2, 40MHz, Single-sided RTT, Ranging, X=50 m | 40M | 1.165 | 1.591 | 1.928 | No | No |
| Case #3, 100MHz, Single-sided RTT, Ranging, X=50 m | 100M | 0.6024 | 0.8075 | 0.9749 | Yes | No |
| Case #4, 20MHz, Single-sided RTT, Ranging, X=100 m | 20M | 2.377 | 3.214 | 3.88 | No | No |
| Case #5, 40MHz, Single-sided RTT, Ranging, X=100 m | 40M | 1.211 | 1.621 | 1.95 | No | No |
| Case #6, 100MHz, Single-sided RTT, Ranging, X=100 m | 100M | 0.6083 | 0.8124 | 0.9769 | Yes | No |
| Case #7, 20MHz, Single-sided RTT, Ranging, X=150 m | 20M | 2.424 | 3.234 | 3.888 | No | No |
| Case #8, 40MHz, Single-sided RTT, Ranging, X=150 m | 40M | 1.224 | 1.632 | 1.956 | No | No |
| Case #9, 100MHz, Single-sided RTT, Ranging, X=150 m | 100M | 0.6078 | 0.8118 | 0.9763 | Yes | No |

## B.1.5 Results from source [22]

### B.1.5.1 Description of evaluation scenarios

Sidelink positioning simulation results of for V2X use cases (including urban grid scenario and highway scenario) and IIoT use cases are provided in this section.

Common assumptions applicable to all evaluated scenarios that are different from or not provided in Tables A.1-1 through A.1-6 are provided in Table B.1.5.1-1.

Table B.1.5.1-1: Common assumptions for sidelink positioning evaluations that are different from or not provided in Annex A.1

|  |  |
| --- | --- |
| **Parameter** | **V2X** |
| Carrier frequency | 6GHz |
| Subcarrier spacing | 30KHz |
| Reference Signal Transmission Bandwidth | 20M/40M/100M |
| Reference Signal Physical Structure and Resource Allocation (RE pattern) | Comb-2, Mode-2 |
| Reference signal including PRS, SRS and SL-PRS  (type of sequence, number of ports, …) | SL-PRS(Gold), 1-port |
| Number of symbols used per occasion | 2 |
| number of occasions used per positioning estimate | 1 |
| Power-boosting level | N/A |
| Uplink power control (applied/not applied) | Not applied |
| interference modelling (ideal muting, or other) | Ideal muting |
| Description of Measurement Algorithm (e.g. super resolution, interference cancellation, ….) | MUSIC |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | Gauss-Newton |
| Synchronization assumptions | Ideal Synchronization |
| UE/gNB RX and TX timing error assumption | No timing error |
| Precoding assumptions (codebook, nrof antenna elements used, etc) | N/A |
| Additional notes, if any | N/A |

Evaluation cases and relevant additional assumptions for highway scenarios for V2X use cases are provided in Table B.1.5.1-2.

Table B.1.5.1-2: Assumptions for sidelink positioning in highway scenarios for V2X use cases that are different from or not provided in Annex A.1

|  |  |
| --- | --- |
| **Parameter** | **highway** |
| UE Antenna model | (1, 2, 2, 1, 1) |
| TRP antenna model | (1, 2, 2, 1, 1) |
| BS/RSU deployment for absolute positioning | As shown in figure 2 |
| BS/RSU deployment for relative positioning/ranging | - |
| Selected values of X (relative positioning or ranging is performed between two UEs within X m) | 20/25/100/150m |
| Positioning method | TDOA(absolute positioning)  RTT+AoA (relative positioning/ranging) |

Evaluation cases and relevant additional assumptions for urban grid scenarios for V2X use cases are provided in Table B.1.5.1-3.

Table B.1.5.1-3: Assumptions for sidelink positioning in urban grid scenarios for V2X use cases that are different from or not provided in Annex A.1

|  |  |
| --- | --- |
| **Parameter** | **urban** |
| UE Antenna model | (1, 2, 2, 1, 1) |
| TRP antenna model | (1, 2, 2, 1, 1) |
| BS/RSU deployment for absolute positioning | As shown in figure 1 |
| BS/RSU deployment for relative positioning/ranging | - |
| Selected values of X (relative positioning or ranging is performed between two UEs within X m) | 10/25m |
| Positioning method | TDOA(absolute positioning)  RTT+AoA (relative positioning/ranging) |

Evaluation cases and relevant additional assumptions for IIoT use cases are provided in Table B.1.5.1-4.

Table B.1.5.1-4: Assumptions for sidelink positioning for IIoT use cases that are different from or not provided in Annex A.1

|  |  |
| --- | --- |
| **Parameter** | **IIoT** |
| UE Antenna model | (1, 2, 2, 1, 1) |
| TRP antenna model | (1, 2, 2, 1, 1) |
| BS/RSU deployment for absolute positioning | As shown in Figure 3 |
| BS/RSU deployment for relative positioning/ranging | - |
| Selected values of X (relative positioning or ranging is performed between two UEs within X m) | 10m |
| Positioning method | RTT+AoA(relative positioning/ranging) |

### B.1.5.2 Positioning accuracy evaluation results for Sidelink Positioning

#### B.1.5.2.1 Positioning accuracy evaluation results for Sidelink Positioning for Highway Scenarios for V2X

Table B.1.5.2.1-1 provides horizontal absolute positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.5.2.1-1: Sidelink positioning - horizontal absolute accuracy for highway scenarios for V2X use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #1, BW#20M, 6GHz, positioning method #TDOA | 0.695 | 1.050 | 1.455 | 2.126 | No  82% of UEs satisfying the target positioning accuracy requirement | No  36% of UEs satisfying the target positioning accuracy requirement |
| Case #2, BW#40M, 6GHz, positioning method#TDOA | 0.443 | 0.697 | 0.997 | 1.420 | Yes | No  55% of UEs satisfying the target positioning accuracy requirement |
| Case #3, BW#100M, 6GHz, positioning method#TDOA | 0.125 | 0.192 | 0.287 | 0.446 | Yes | Yes |

Table B.1.5.2.1-2- B.1.5.2.1-5 provides horizontal relative positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.5.2.1-2: Sidelink positioning - horizontal relative accuracy (X=20m) for highway scenarios for V2X use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #4, BW#20M, 6GHz, positioning method #RTT+AoA | 1.358 | 2.653 | 2.685 | 3.253 | No  54% of UEs satisfying the target positioning accuracy requirement | No  23.5% of UEs satisfying the target positioning accuracy requirement |
| Case #5, BW#40M, 6GHz, positioning method #RTT+AoA | 0.471 | 0.820 | 1.203 | 1.494 | Yes | No  54% of UEs satisfying the target positioning accuracy requirement |

Table B.1.5.2.1-3: Sidelink positioning - horizontal relative accuracy (X=25m) for highway scenarios for V2X use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #6, BW#20M, 6GHz, positioning method #RTT+AoA | 2.037 | 2.990 | 3.900 | 4.801 | No  38.6% of UEs satisfying the target positioning accuracy requirement | No  12.7% of UEs satisfying the target positioning accuracy requirement |
| Case #7, BW#40M, 6GHz, positioning method #RTT+AoA | 0.631 | 0.875 | 1.453 | 2.010 | No  83% of UEs satisfying the target positioning accuracy requirement | No  39% of UEs satisfying the target positioning accuracy requirement |
| Case #8, BW#100M, 6GHz, positioning method #RTT+AoA | 0.145 | 0.258 | 0.594 | 0.791 | Yes | No  71% of UEs satisfying the target positioning accuracy requirement |

Table B.1.5.2.1-4: Sidelink positioning - horizontal relative accuracy (X=100m) for highway scenarios for V2X use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #9, BW#20M, 6GHz, positioning method #RTT+AoA | 1.739 | 2.932 | 4.504 | 7.270 | No  44% of UEs satisfying the target positioning accuracy requirement | No  16% of UEs satisfying the target positioning accuracy requirement |
| Case #10, BW#40M, 6GHz, positioning method #RTT+AoA | 1.325 | 2.154 | 3.385 | 5.231 | No  54% of UEs satisfying the target positioning accuracy requirement | No  23.5% of UEs satisfying the target positioning accuracy requirement |
| Case #11, BW#100M, 6GHz, positioning method #RTT+AoA | 0.8705 | 1.500 | 2.891 | 4.467 | No  67% of UEs satisfying the target positioning accuracy requirement | No  35% of UEs satisfying the target positioning accuracy requirement |

Table B.1.5.2.1-5: Sidelink positioning - horizontal relative accuracy (X=150m) for highway scenarios for V2X use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #12, BW#20M, 6GHz, positioning method #RTT+AoA | 2.175 | 3.570 | 5.700 | 9.613 | No  38.6% of UEs satisfying the target positioning accuracy requirement | No  12.7% of UEs satisfying the target positioning accuracy requirement |
| Case #13, BW#40M, 6GHz, positioning method #RTT+AoA | 1.628 | 2.815 | 4.617 | 7.474 | No  48% of UEs satisfying the target positioning accuracy requirement | No  19% of UEs satisfying the target positioning accuracy requirement |
| Case #14, BW#100M, 6GHz, positioning method #RTT+AoA | 1.119 | 2.250 | 3.572 | 6.197 | No  57% of UEs satisfying the target positioning accuracy requirement | No  29% of UEs satisfying the target positioning accuracy requirement |

Table B.1.5.2.1-6- B.1.5.2.1-9 provide ranging distance accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.5.2.1-6: Sidelink positioning - ranging distance accuracy (X=20m) for highway scenarios for V2X use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #4, BW#20M, 6GHz, positioning method #RTT | 0.750 | 0.960 | 1.809 | 2.371 | Yes | No  If not, 36% of UEs satisfying the target positioning accuracy requirement |
| Case #5, BW#40M, 6GHz, positioning method #RTT | 0.490 | 0.623 | 1.008 | 1.264 | Yes | No  If not, 66% of UEs satisfying the target positioning accuracy requirement |

Table B.1.5.2.1-7: Sidelink positioning - ranging distance accuracy (X=25m) for highway scenarios for V2X use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #6, BW#20M, 6GHz, positioning method #RTT | 0. 475 | 0.740 | 1.582 | 2.050 | No  If not, 79% of UEs satisfying the target positioning accuracy requirement | No  If not, 57% of UEs satisfying the target positioning accuracy requirement |
| Case #7, BW#40M, 6GHz, positioning method #RTT | 0.258 | 0.688 | 0.845 | 1.298 | Yes | No  If not, 60% of UEs satisfying the target positioning accuracy requirement |
| Case #8, BW#100M, 6GHz, positioning method #RTT | 0.074 | 0.115 | 0.160 | 0.231 | Yes | Yes |

Table B.1.5.2.1-8: Sidelink positioning - ranging distance accuracy (X=100m) for highway scenarios for V2X use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #9, BW#20M, 6GHz, positioning method #RTT | 0.310 | 0.520 | 0.781 | 1.309 | Yes | No  If not, 66% of UEs satisfying the target positioning accuracy requirement |
| Case #10, BW#40M, 6GHz, positioning method #RTT | 0.135 | 0.243 | 0.400 | 0.680 | Yes | No  If not, 85% of UEs satisfying the target positioning accuracy requirement |
| Case #11, BW#100M, 6GHz, positioning method #RTT | 0.047 | 0.099 | 0.166 | 0.269 | Yes | Yes |

Table B.1.5.2.1-9: Sidelink positioning - ranging distance accuracy (X=150m) for highway scenarios for V2X use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #12, BW#20M, 6GHz, positioning method #RTT | 0.284 | 0.500 | 0.783 | 1.302 | Yes | No  If not, 67% of UEs satisfying the target positioning accuracy requirement |
| Case #13, BW#40M, 6GHz, positioning method #RTT | 0.136 | 0.246 | 0.409 | 0.683 | Yes | No  If not, 85% of UEs satisfying the target positioning accuracy requirement |
| Case #14, BW#100M, 6GHz, positioning method #RTT | 0.053 | 0.098 | 0.175 | 0.292 | Yes | Yes |

Table B.1.5.2.1-10- B.1.5.2.1-13 provide ranging angle accuracy results using sidelink positioning for highway scenarios for V2X use cases.

TableB.1.5.2.1-10: Sidelink positioning - ranging angle accuracy (X=20m) for highway scenarios for V2X use cases

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the target requirement** |
| Case #4, BW#20M, 6GHz, positioning method #AoA | 2.18° | 3.61° | 5.46° | 8.66° | Yes |
| Case #5, BW#40M, 6GHz, positioning method #AoA | 1.06° | 1.71° | 2.00° | 3.20° | Yes |

TableB.1.5.2.1-11: Sidelink positioning - ranging angle accuracy (X=25m) for highway scenarios for V2X use cases

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the target requirement** |
| Case #6, BW#20M, 6GHz, positioning method #AoA | 7.60° | 13.65° | 15.60° | 17.90° | No  80.0% of UEs satisfying the target positioning accuracy requirement |
| Case #7, BW#40M, 6GHz, positioning method #AoA | 1.65° | 5.64° | 10.00° | 12.89° | Yes |
| Case #8, BW#100M, 6GHz, positioning method #AoA | 1.21° | 2.01° | 2.42° | 3.44° | Yes |

TableB.1.5.2.1-12: Sidelink positioning - ranging angle accuracy (X=100m) for highway scenarios for V2X use cases

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the target requirement** |
| Case #9, BW#20M, 6GHz, positioning method #AoA | 2.14° | 3.57° | 5.36° | 8.52° | Yes |
| Case #10, BW#40M, 6GHz, positioning method #AoA | 1.72° | 2.70° | 4.09° | 6.26° | Yes |
| Case #11, BW#100M, 6GHz, positioning method #AoA | 1.14° | 1.95° | 3.45° | 4.79° | Yes |

TableB.1.5.2.1-13: Sidelink positioning - ranging angle accuracy (X=150m) for highway scenarios for V2X use cases

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the target requirement** |
| Case #12, BW#20M, 6GHz, positioning method #AoA | 2.00° | 3.18° | 5.00° | 8.30° | Yes |
| Case #13, BW#40M, 6GHz, positioning method #AoA | 1.59° | 2.50° | 3.73° | 5.88° | Yes |
| Case #14, BW#100M, 6GHz, positioning method #AoA | 1.06° | 1.86° | 3.26° | 4.65° | Yes |

#### B.1.5.2.2 Positioning accuracy evaluation results for Sidelink Positioning for Urban Grid Scenarios for V2X

Table B.1.5.2.2-1 provides horizontal absolute positioning accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.5.2.2-1: Sidelink positioning - horizontal absolute accuracy for urban grid scenarios for V2X use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #15, BW#20M, 6GHz, positioning method #TDOA | 2.387 | 4.090 | 6.608 | 9.822 | No  38% of UEs satisfying the target positioning accuracy requirement | No  11% of UEs satisfying the target positioning accuracy requirement |
| Case #16, BW#40M, 6GHz, positioning method#TDOA, 6GHz | 0.930 | 1.615 | 3.074 | 5.114 | No  65% of UEs satisfying the target positioning accuracy requirement | No  30% of UEs satisfying the target positioning accuracy requirement |
| Case #17, BW#100M, 6GHz, positioning method#TDOA | 0.290 | 0.5134 | 0.918 | 1.559 | No  89.5% of UEs satisfying the target positioning accuracy requirement | No  66% of UEs satisfying the target positioning accuracy requirement |

Table B.1.5.2.2-2- B.1.5.2.2-3 provides horizontal relative positioning accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.5.2.2-2: Sidelink positioning - horizontal relative accuracy (X=10m) for urban grid scenarios for V2X use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #18, BW#40M, 6GHz, positioning method #RTT+AoA | 0.597 | 0.900 | 1.497 | 1.982 | No  81.8% of UEs satisfying the target positioning accuracy requirement | No  40.4% of UEs satisfying the target positioning accuracy requirement |
| Case #19, BW#100M, 6GHz, positioning method #RTT+AoA | 0.248 | 0.410 | 0.899 | 1.321 | Yes | No  73% of UEs satisfying the target positioning accuracy requirement |

Table B.1.5.2.2-3: Sidelink positioning - horizontal relative accuracy (X=25m) for urban grid scenarios for V2X use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #20, BW#20M, 6GHz, positioning method #RTT+AoA | 1.620 | 2.382 | 3.351 | 4.610 | No  46.5% of UEs satisfying the target positioning accuracy requirement | No  11% of UEs satisfying the target positioning accuracy requirement |
| Case #21, BW#40M, 6GHz, positioning method #RTT+AoA | 1.301 | 1.999 | 2.802 | 4.070 | No  55.8% of UEs satisfying the target positioning accuracy requirement | No  18.4% of UEs satisfying the target positioning accuracy requirement |
| Case #22, BW#100M, 6GHz, positioning method #RTT+AoA | 1.148 | 1.811 | 2.659 | 3.900 | No  59% of UEs satisfying the target positioning accuracy requirement | No  23% of UEs satisfying the target positioning accuracy requirement |

Table B.1.5.2.2-4- B.1.5.2.2-5 provides ranging distance accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.5.2.2-4: Sidelink positioning - ranging distance accuracy (X=10m) for urban grid scenarios for V2X use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #18, BW#40M, 6GHz, positioning method #RTT | 0.120 | 0.239 | 0.395 | 0.666 | Yes | No  86% of UEs satisfying the target positioning accuracy requirement |
| Case #19, BW#100M, 6GHz, positioning method #RTT | 0.089 | 0.122 | 0.150 | 0.172 | Yes | Yes |

Table B.1.5.2.2-5: Sidelink positioning - ranging distance accuracy (X=25m) for urban grid scenarios for V2X use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #20, BW#20M, 6GHz, positioning method #RTT | 0.344 | 0.567 | 0.878 | 1.354 | Yes | No  63% of UEs satisfying the target positioning accuracy requirement |
| Case #21, BW#40M, 6GHz, positioning method #RTT | 0.140 | 0.243 | 0.413 | 0.650 | Yes | No  85% of UEs satisfying the target positioning accuracy requirement |
| Case #22, BW#100M, 6GHz, positioning method #RTT | 0.061 | 0.094 | 0.135 | 0.241 | Yes | Yes |

Table B.1.5.2.2-6- B.1.5.2.2-7 provides ranging angle accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.5.2.2-6: Sidelink positioning - ranging angle accuracy (X=10m) for urban grid scenarios for V2X use cases

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the target requirement** |
| Case #18, BW#40M, 6GHz, positioning method #AoA | 2.31° | 4.45° | 9.58° | 12.70° | Yes |
| Case #19, BW#100M, 6GHz, positioning method #AoA | 3.53° | 5.80° | 8.82° | 12.60° | Yes |

Table B.1.5.2.2-7: Sidelink positioning - ranging angle accuracy (X=25m) for urban grid scenarios for V2X use cases

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the target requirement** |
| Case #20, BW#20M, 6GHz, positioning method #AoA | 6.38° | 8.91° | 12.41° | 16.71° | No  87.5% of UEs satisfying the target positioning accuracy requirement |
| Case #21, BW#40M, 6GHz, positioning method #AoA | 5.65° | 8.01° | 10.83° | 14.95° | Yes |
| Case #22, BW#100M, 6GHz, positioning method #AoA | 5.32° | 7.69° | 10.5° | 14.36° | Yes |

#### B.1.5.2.3 Positioning accuracy evaluation results for Sidelink Positioning for IIoT

Table B.1.5.2.3-1 provides horizontal relative positioning accuracy results using sidelink positioning for IIoT use cases.

Table B.1.5.2.3-1: Sidelink positioning - horizontal relative accuracy (X=10m) for IIoT use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #23, BW#40M, 6GHz, positioning method #RTT+AoA | 0.400 | 0.438 | 0.556 | 0.830 | Yes | No  41% of UEs satisfying the target positioning accuracy requirement |
| Case #24, BW#100M, 6GHz, positioning method #RTT+AoA | 0.131 | 0.152 | 0.169 | 0.255 | Yes | No  83% of UEs satisfying the target positioning accuracy requirement |

Table B.1.5.2.3-2 provides ranging distance accuracy results using sidelink positioning for IIoT use cases.

Table B.1.5.2.3-2: Sidelink positioning - ranging distance accuracy (X=10m) for IIoT use cases

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** |
| Case #23, BW#40M, 6GHz, positioning method #RTT | 0.256 | 0.379 | 0.440 | 0.712 | Yes | No  If not, 85% of UEs satisfying the target positioning accuracy requirement |
| Case #24, BW#100M, 6GHz, positioning method #RTT | 0.100 | 0.135 | 0.156 | 0.177 | Yes | Yes |

Table B.1.5.2.3-3 provides ranging distance accuracy results using sidelink positioning for IIoT use cases.

Table B.1.5.2.3-3: Sidelink positioning - ranging angle accuracy (X=10m) for IIoT use cases

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the target requirement** |
| Case #23, BW#40M, 6GHz, positioning method #AoA | 1.62° | 2.13° | 2.74° | 5.12° | Yes |
| Case #24, BW#100M, 6GHz, positioning method #AoA | 0.41° | 0.70° | 1.15° | 1.73° | Yes |

## B.1.6 Results from source [23]

### B.1.6.1 Description of evaluation scenarios

Table B.1.6.1-1 provides the common assumptions applicable to all evaluated scenarios.

Table B.1.6.1-2 provides the assumptions for highway if they are different from or not specified in Agreements.

Table B.1.6.1-3 provides the assumptions for urban grid if they are different from or not specified in the agreements.

**Table B.1.6.1-1: Common assumptions for sidelink positioning evaluations that are different from or not provided in Annex A.1**

|  |  |
| --- | --- |
| **Parameter** |  |
| Carrier frequency | 6GHz |
| Subcarrier spacing | 30kHz |
| Reference Signal Transmission Bandwidth | 100MHz or 20MHz |
| Reference Signal Physical Structure and Resource Allocation (RE pattern) | Comb-2 |
| Reference signal including PRS, SRS and SL-PRS  (type of sequence, number of ports, …) | ZC-based |
| Number of symbols used per occasion | 2 symbols |
| number of occasions used per positioning estimate | 1 |
| Power-boosting level | 0dB |
| Uplink power control (applied/not applied) | Not applied |
| interference modelling (ideal muting, or other) | Ideal muting |
| Description of Measurement Algorithm (e.g. super resolution, interference cancellation, ….) | Super resolution in channel estimation.  Threshold based first path detection |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | Maximum likelihood estimator for absolute coordinate calculation |
| Synchronization assumptions | Ideal synchronization |
| UE/gNB RX and TX timing error assumption | Ideal timing error calibration |
| Precoding assumptions (codebook, nrof antenna elements used, etc) | Codebook based beam sweeping |
| Additional notes, if any | Run 10 simulations per test case. Each simulation deploys with different channel and UE drops. |

**Table B.1.6.1-2: Assumptions for highway if they are different from or not specified in Annex A.1**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 1 | | Case 2 | | Case 3 | Case 4 | |
| Simulation Bandwidth | 100 MHz | | 40 MHz | | 20 MHz | 100MHz | |
| LOS condition | Channel model defined in 37.855 | | Channel model defined in 37.855 | | Channel model defined in 37.855 | LOS only | |
| Vehicle antenna model, array configuration  () | Rooftop antenna  (1, 2, 2, 1, 1) | | Rooftop antenna  (1, 2, 2, 1, 1) | | Rooftop antenna  (1, 2, 2, 1, 1) | Rooftop antenna  (1, 2, 2, 1, 1) | |
| RSU antenna model, array configuration () | (1, 2, 2, 1, 1) | | (1, 2, 2, 1, 1) | | (1, 2, 2, 1, 1) | (1, 2, 2, 1, 1) | |
| RSU deployment for absolute positioning | Staggered RSU distribution with 200m RSU spacing like:  A picture containing text, clock, watch  Description automatically generated | | | | | | |
| RSU deployment for relative positioning/ranging | Same as aboslute position | | | | | | |
| Selected values of **X** (relative positioning or ranging is performed between two UEs within **X** m) | Vehicle: **X** = 50  RSU: **X** = 300 | Vehicle: **X** = 50  RSU: **X** = 300 | | Vehicle: **X** = 50  RSU: **X** = 300 | | | Vehicle: **X** = 50  RSU: **X** = 300 |
| Positioning method | Relative positioning based on one RTT and one AOA measurement  Absolute positioning using TDOA. | | | | | | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameters** | Case 6 | Case 7 | Case 8 | Case 9 |
| Simulation Bandwidth | 40 MHz | 20MHz | 100 MHz | 100 MHz |
| LOS condition | LOS only | LOS only | Channel model defined in 37.855 | Channel model defined in 37.855 |
| Vehicle antenna model, array configuration  () | Rooftop antenna  (1, 2, 2, 1, 1) | Rooftop antenna  (1, 2, 2, 1, 1) | Rooftop antenna  (1, 2, 2, 1, 1) | Rooftop antenna  (1, 2, 2, 1, 1) |
| RSU antenna model, array configuration () | (1, 2, 2, 1, 1) | (1, 2, 2, 1, 1) | (1, 2, 2, 1, 1) | (1, 2, 2, 1, 1) |
| RSU deployment for absolute positioning | Staggered RSU distribution with 200m RSU spacing like:  A picture containing text, clock, watch  Description automatically generated | | | |
| RSU deployment for relative positioning/ranging | Same as aboslute position | | | |
| Selected values of **X** (relative positioning or ranging is performed between two UEs within **X** m) | Vehicle: **X** = 50  RSU: **X** = 300 | Vehicle: **X** = 50  RSU: **X** = 300 | Vehicle: **X** = 100  RSU: **X** = 300 | Vehicle: **X** = 150  RSU: **X** = 300 |
| Positioning method | Relative positioning based on one RTT and one AOA measurement  Absolute positioning using TDOA. | | | |

**Table B.1.6.1-3: Assumptions for urban grid if they are different from or not specified in the Annex A.1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameters** | Case 5 | Case 6 | Case 7 | Case 8 |
| Simulation Bandwidth | 100 MHz | 40 MHz | 20 MHz | 100MHz |
| LOS condition | Channel model defined in 37.855 | Channel model defined in 37.855 | Channel model defined in 37.855 | LOS only |
| Vehicle antenna model, array configuration  () | Rooftop antenna  (1, 2, 2, 1, 1) | Rooftop antenna  (1, 2, 2, 1, 1) | Rooftop antenna  (1, 2, 2, 1, 1) | Rooftop antenna  (1, 2, 2, 1, 1) |
| RSU antenna model, array configuration () | (1, 2, 2, 1, 1) | (1, 2, 2, 1, 1) | (1, 2, 2, 1, 1) | (1, 2, 2, 1, 1) |
| RSU deployment for absolute positioning | RSU deployment follows the description in TR 36.885 section A1.3. | | | |
| RSU deployment for relative positioning/ranging | RSU deployment follows the description in TR 36.885 section A1.3. | | | |
| Selected values of **X** (relative positioning or ranging is performed between two UEs within **X** m) | 30 | 30 | 30 | 30 |
| Positioning method | Relative positioning based on RTT and AOA measurement. | | | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameters** | Case 9 | Case 10 | Case 11 | Case 12 |
| Simulation Bandwidth | 40 MHz | 20 MHz | 100 MHz | 20MHz |
| LOS condition | LOS only | LOS only | Channel model defined in 37.855 | Channel model defined in 37.855 |
| Vehicle antenna model, array configuration  () | Rooftop antenna  (1, 2, 2, 1, 1) | Rooftop antenna  (1, 2, 2, 1, 1) | Rooftop antenna  (1, 2, 2, 1, 1) | Rooftop antenna  (1, 2, 2, 1, 1) |
| RSU antenna model, array configuration () | (1, 2, 2, 1, 1) | (1, 2, 2, 1, 1) | (1, 2, 2, 1, 1) | (1, 2, 2, 1, 1) |
| RSU deployment for absolute positioning | RSU deployment follows the description in TR 36.885 section A1.3. | | | |
| RSU deployment for relative positioning/ranging | RSU deployment follows the description in TR 36.885 section A1.3. | | | |
| Selected values of **X** (relative positioning or ranging is performed between two UEs within **X** m) | 30 | 30 | 10 | 50 |
| Positioning method | Relative positioning based on RTT and AOA measurement. | | | |

B.1.6.2 Positioning accuracy evaluation results for Sidelink Positioning

Sidelink positioning simulation results for V2X use cases (including highway scenario and urban grid scenario) are provided in this section.

B.1.6.2.1 Positioning accuracy evaluation results for Sidelink Positioning for Highway Scenarios for V2X

Table B.1.6.2.1-1 provides simulation results for highway for absolute positioning - horizontal accuracy (m).

Table B.1.6.2.1-2 provides simulation results for highway for relative positioning - horizontal accuracy (m).

Table B.1.6.2.1-3 provides simulation results for highway for ranging - distance accuracy (m).

Table B.1.6.2.1-4 provides simulation results for highway for ranging positioning - angle accuracy (degree).

**Table B.1.6.2.1-1: Simulation results for highway for absolute positioning - horizontal accuracy (m)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1, BW100MHz, FR1, positioning method: TDOA, X = 50 m | 0.22 | 0.35 | 0.52 | 0.85 | Yes | No, 79% of UEs satisfying the target positioning accuracy requirement |
| Case 2, BW40M, FR1, positioning method: TDOA, X = 50 m | 1.09 | 1.61 | 2.07 | 3.06 | No, 65% of UEs satisfying the target positioning | No, 20% of UEs satisfying the target positioning accuracy requirement |
| Case 3, BW20M, FR1, positioning method: TDOA, X = 50 m | 2.03 | 2.82 | 4.41 | 6.04 | No, 34% of UEs satisfying the target positioning accuracy requirement | No, 7% of UEs satisfying the target positioning accuracy requirement |
| Case 4, BW100M, FR1, positioning method: TDOA, LOS only, X = 50 m | 0.19 | 0.30 | 0.43 | 0.63 | Yes | No, 84% of UEs satisfying the target positioning accuracy requirement |
| Case 5, BW40M, FR1, positioning method: TDOA, LOS only, X = 50 m | 0.98 | 1.39 | 1.89 | 2.55 | No, 70% of UEs satisfying the target positioning | No, 24% of UEs satisfying the target positioning accuracy requirement |
| Case 6, BW20M, FR1, positioning method: TDOA, LOS only, X = 50 m | 1.92 | 2.29 | 3.63 | 5.42 | No, 40% of UEs satisfying the target positioning accuracy requirement | No, 8% of UEs satisfying the target positioning accuracy requirement |

**Table B.1.6.2.1-2: Simulation results for highway for relative positioning - horizontal accuracy (m)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1, BW100MHz, FR1, positioning method: RTT+AoA, X = 50 m | 0.25 | 0.49 | 1.06 | 3.25 | No, 85% of UEs satisfying the target positioning accuracy requirement | No, 67% of UEs satisfying the target positioning accuracy requirement |
| Case 2, BW40MHz, FR1, positioning method: RTT+AoA, X = 50 m | 0.65 | 0.97 | 1.66 | 4.27 | No, 77% of UEs satisfying the target positioning accuracy requirement | No, 35% of UEs satisfying the target positioning accuracy requirement |
| Case 3, BW20M, FR1, positioning method: RTT+AoA, X = 50 m | 1.21 | 1.84 | 2.93 | 5.94 | No, 58% of UEs satisfying the target positioning accuracy requirement | No, 15% of UEs satisfying the target positioning accuracy requirement |
| Case 4, BW100M, FR1, positioning method: RTT+AoA, LOS only, X = 50 m | 0.24 | 0.46 | 0.98 | 2.86 | No, 85% of UEs satisfying the target positioning | No, 67% of UEs satisfying the target positioning accuracy requirement |
| Case 5, BW40M, FR1, positioning method: RTT+AoA, LOS only, X = 50 m | 0.64 | 0.93 | 1.54 | 3.82 | No, 79% of UEs satisfying the target positioning accuracy requirement | No, 35% of UEs satisfying the target positioning accuracy requirement |
| Case 6, BW20M, FR1, positioning method: RTT+AoA, LOS only, X = 50 m | 1.18 | 1.79 | 2.79 | 5.55 | No, 60% of UEs satisfying the target positioning accuracy requirement | No, 15% of UEs satisfying the target positioning accuracy requirement |
| Case 7, BW100MHz, FR1, positioning method: RTT+AoA, X = 100 m | 0.65 | 1.43 | 2.84 | 6.69 | No, 68% of UEs satisfying the target positioning accuracy requirement | No, 44% of UEs satisfying the target positioning accuracy requirement |
| Case 8, BW100MHz, FR1, positioning method: RTT+AoA, X = 150 m | 1.20 | 2.53 | 4.62 | 9.02 | No, 54% of UEs satisfying the target positioning accuracy requirement | No, 32% of UEs satisfying the target positioning accuracy requirement |

**Table B.1.6.2.1-3: Simulation results for highway for ranging - distance accuracy (m)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1, BW100MHz, FR1, positioning method: RTT, X = 50 m | 0.09 | 0.14 | 0.21 | 0.45 | Yes | Yes |
| Case 2, BW40MHz, FR1, positioning method: RTT, X = 50 m | 0.4611 | 0.64 | 0.89 | 1.59 | No, 89% of UEs satisfying the target positioning | No, 54% of UEs satisfying the target positioning accuracy requirement |
| Case 3, BW20M, FR1, positioning method: TDOA, RTT, X = 50 m | 0.85 | 1.93 | 1.93 | 3.55 | No, 73% of UEs satisfying the target positioning accuracy requirement | No, 29% of UEs satisfying the target positioning accuracy requirement |
| Case 4, BW100M, FR1, positioning method: RTT, LOS only, X = 50 m | 0.09 | 0.13 | 0.21 | 0.44 | Yes | Yes |
| Case 5, BW40M, FR1, positioning method: RTT, LOS only, X = 50 m | 0.45 | 0.63 | 0.86 | 1.48 | Yes | No, 54% of UEs satisfying the target positioning accuracy requirement |
| Case 6, BW20M, FR1, positioning method: RTT, LOS only, X = 50 m | 0.45 | 0.63 | 0.86 | 3.34 | No, 84% of UEs satisfying the target positioning accuracy requirement | No, 29% of UEs satisfying the target positioning accuracy requirement |
| Case 7, BW100MHz, FR1, positioning method: RTT, X = 100 m | 0.09 | 0.14 | 0.24 | 0.57 | Yes | No (but almost) |
| Case 8, BW100MHz, FR1, positioning method: RTT, X = 150 m | 0.09 | 0.14 | 0.24 | 0.62 | Yes | No, 88% of UEs satisfying the target positioning accuracy requirement |

**Table B.1.6.2.1-4: Simulation results for highway for ranging positioning - angle accuracy (degree)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1, BW100MHz, FR1, positioning method: AOA, X = 50m | 0.42 | 0.78 | 1.49 | 3.76 | Yes | Yes |
| Case 2, BW40MHz, FR1, positioning method: AOA, X = 50m | 0.73 | 1.31 | 2.43 | 5.13 | Yes | Yes |
| Case 3, BW20M, FR1, positioning method: AOA, X =50m | 1.20 | 2.10 | 3.52 | 6.77 | Yes | Yes |
| Case 4, BW100M, FR1, positioning method: AOA, LOS only, X =50m | 0.45 | 0.63 | 0.86 | 1.48 | Yes | Yes |
| Case 5, BW40M, FR1, positioning method: AOA, LOS only, X =50m | 0.65 | 1.17 | 1.96 | 3.90 | Yes | Yes |
| Case 6, BW20M, FR1, positioning method: AOA, LOS only, X =50m | 1.09 | 1.85 | 3.04 | 5.73 | Yes | Yes |
| Case 7, BW100MHz, FR1, positioning method: AOA, X = 100m | 0.67 | 1.25 | 2.23 | 4.79 | Yes | Yes |
| Case 8, BW100MHz, FR1, positioning method: AOA, X = 150m | 0.68 | 1.27 | 2.26 | 4.89 | Yes | Yes |

B.1.6.2.2 Positioning accuracy evaluation results for Sidelink Positioning for Highway Scenarios for V2X

Table B.1.6.2.2-1 provides simulation results for urban grid for relative positioning - horizontal accuracy (m).

Table B.1.6.2.2-2 provides simulation results for urban grid for ranging - distance accuracy (m).

Table B.1.6.2.2-3 provides simulation results for urban grid for ranging positioning - angle accuracy.

**Table B.1.6.2.2-1: Simulation results for urban grid for relative positioning - horizontal accuracy (m)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 9, BW100MHz, FR1, positioning method: RTT+AOA, X = 30m | 0.22 | 0.40 | 0.81 | 2.95 | No, 85% of UEs satisfying the target positioning | No, 70% of UEs satisfying the target positioning accuracy requirement |
| Case 10, BW40MHz, FR1, positioning method: RTT+AOA, X = 30m | 0.73 | 1.12 | 1.90 | 4.62 | No, 75% of UEs satisfying the target positioning accuracy requirement | No, 33% of UEs satisfying the target positioning accuracy requirement |
| Case 11, BW20M, FR1, positioning method: RTT+AOA, X = 30m | 1.63 | 2.57 | 3.82 | 6.94 | No, 45% of UEs satisfying the target positioning accuracy requirement | No, 12% of UEs satisfying the target positioning accuracy requirement |
| Case 12, BW100M, FR1, positioning method: RTT+AOA, LOS only, X = 30m | 0.43 | 0.59 | 0.78 | 1.17 | Yes | No, 57% of UEs satisfying the target positioning accuracy requirement |
| Case 13, BW40M, FR1, positioning method: RTT+AOA, LOS only, X = 30m | 0.69 | 1.00 | 1.58 | 3.20 | No, 78% of UEs satisfying the target positioning accuracy requirement | No, 35% of UEs satisfying the target positioning accuracy requirement |
| Case 14, BW20M, FR1, positioning method: RTT+AOA, LOS only, X = 30m | 1.52 | 2.32 | 3.39 | 5.61 | No, 50% of UEs satisfying the target positioning accuracy requirement | No, 13% of UEs satisfying the target positioning accuracy requirement |
| Case 15, BW100MHz, FR1, positioning method: RTT+AOA, X = 10m | 0.10 | 0.16 | 0.27 | 0.60 | Yes | No, 88% of UEs satisfying the target positioning accuracy requirement |
| Case 16, BW100MHz, FR1, positioning method: RTT+AOA, X = 50m | 0.39 | 0.86 | 2.73 | 9.52 | No, 75% of UEs satisfying the target positioning accuracy requirement | No, 55% of UEs satisfying the target positioning accuracy requirement |

**Table B.1.6.2.2-2: Simulation results for urban grid for ranging - distance accuracy (m)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 9, BW100MHz, FR1, positioning method: RTT, X = 30m | 0.09 | 0.14 | 0.26 | 0.62 | Yes | No, 88% of UEs satisfying the target positioning accuracy requirement |
| Case 10, BW40MHz, FR1, positioning method: RTT, X = 30m | 0.52 | 0.77 | 1.15 | 2.04 | No, 85% of UEs satisfying the target positioning | No, 50% of UEs satisfying the target positioning accuracy requirement |
| Case 11, BW20M, FR1, positioning method: RTT, X= 30m | 1.23 | 1.95 | 2.90 | 4.56 | No, 57% of UEs satisfying the target positioning accuracy requirement | No, 22% of UEs satisfying the target positioning accuracy requirement |
| Case 12, BW100M, FR1, positioning method: RTT, LOS only, X= 30m | 0.08 | 0.13 | 0.24 | 0.52 | Yes | No (but almost) |
| Case 13, BW40M, FR1, positioning method: RTT, LOS only, X= 30m | 0.51 | 0.74 | 1.08 | 1.81 | No, 86% of UEs satisfying the target positioning | No, 50% of UEs satisfying the target positioning accuracy requirement |
| Case 14, BW20M, FR1, positioning method: RTT, LOS only, X= 30m | 1.19 | 1.85 | 2.77 | 4.29 | No, 70% of UEs satisfying the target positioning accuracy requirement | No, 21% of UEs satisfying the target positioning accuracy requirement |
| Case 15, BW100MHz, FR1, positioning method: RTT, X = 10m | 0.07 | 0.11 | 0.17 | 0.38 | Yes | Yes |
| Case 16, BW100MHz, FR1, positioning method: RTT, X = 50m | 0.10 | 0.17 | 0.38 | 2.12 | No | No, 82% of UEs satisfying the target positioning accuracy requirement |

**Table B.1.6.2.2-3: Simulation results for urban grid for ranging positioning - angle accuracy**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 9, BW100MHz, FR1, positioning method: AOA, X = 30m | 0.57 | 1.05 | 2.09 | 6.23 | Yes | Yes |
| Case 10, BW40MHz, FR1, positioning method: AOA, X = 30m | 0.97 | 1.81 | 3.49 | 8.17 | Yes | No(almost) |
| Case 11, BW20M, FR1, positioning method: AOA, X = 30m | 1.82 | 3.30 | 5.44 | 10.04 | Yes | No, 87% of UEs satisfying the target positioning accuracy requirement |
| Case 12, BW100M, FR1, positioning method: AOA, LOS only, X = 30m | 0.52 | 0.92 | 1.71 | 4.30 | Yes | Yes |
| Case 13, BW40M, FR1, positioning method: AOA, LOS only, X = 30m | 0.89 | 1.61 | 2.81 | 6.16 | Yes | Yes |
| Case 14, BW20M, FR1, positioning method: AOA, LOS only, X = 30m | 1.67 | 2.98 | 4.74 | 8.07 | Yes | No(almost) |
| Case 15, BW100MHz, FR1, positioning method: AOA, X = 10m | 0.35 | 0.60 | 1.06 | 2.53 | Yes | Yes |
| Case 16, BW100MHz, FR1, positioning method: AOA, X = 50m | 0.77 | 1.61 | 3.93 | 10.87 | Yes | No, 87% of UEs satisfying the target positioning accuracy requirement |

B.1.7 Results from source [24]

B.1.7.1 Description of evaluation scenarios

Based on the agreement in RAN1#109e and RAN1#110 meeting, sidelink positioning is evaluated in V2X use case with highway scenario and urban grid scenario, IIOT use case, public safety use case and commercial use case. For IIOT use case, indoor factory scenario defined in TR 38.857 is used to evaluate. As typical scenarios of InF, InF-SH and InF-DH are evaluated. For public safety use case, RMa scenario can be adopted to be evaluated as a typical scenario of public safety. For commercial use case, indoor office scenario can be adopted to be evaluated as a typical scenario of commercial use case.

Common assumptions applicable to all evaluated scenarios that are different from or not provided in Tables A.1-1 through A.1-6 are provided in Table B.1.7.1-1.

**Table B.1.7.1-1: Common assumptions for sidelink positioning evaluations that are different from or not provided in Annex A.1 from [24]**

|  |  |
| --- | --- |
| **Parameter** |  |
| Carrier frequency | Uu: 4GHz  SL: 6GHz |
| Subcarrier spacing | 30KHz |
| UE or UE type RSU antenna configuration | (M, N, P, Mg, Ng) = (1, 4, 2, 1, 1) |
| Comb size | 4 |
| Interference modelling (ideal muting, or other) | Ideal muting |
| Description of measurement algorithm (e.g. super resolution, interference cancellation, ….) | MUSIC algorithm |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | Absolute positioning: TDOA with Gauss-Newton algorithm;  Relative positioning/ranging: RTT, or AOA |
| Synchronization assumptions | Perfect synchronization |
| Precoding assumptions (codebook, etc) | No precoding |

Evaluation cases for highway scenarios for V2X use cases are provided in Table B.1.7.1-2 and Table B.1.7.1-3.

**Table B.1.7.1-2: Assumptions for sidelink positioning in highway scenarios for V2X use cases that are different from or not provided in Annex A.1 from [24]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | **Case 1** | **Case 2** | **Case 3** | **Case 4** | **Case 5** | **Case 6** |
| Anchor nodes | Joint | Joint | Joint | SL only | SL only | SL only |
| Bandwidth | 100MHz | 40MHz | 20MHz | 100MHz | 40MHz | 20MHz |

**Table B.1.7.1-3: Assumptions for sidelink positioning in highway scenarios for V2X use cases that are different from or not provided in Annex A.1 from [24]**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | **Case 7** | **Case 8** | **Case 9** | **Case 10** | **Case 11** | **Case 12** | **Case 13** | **Case 14** |
| X | 50 | 50 | 50 | 100 | 100 | 100 | 150 | 150 |
| Bandwidth | 20M | 40M | 100M | 20M | 40M | 100M | 20M | 40M |
| Link type | All link | All link | All link | All link | All link | All link | All link | All link |
| **Parameters** | **Case 15** | **Case 16** | **Case 17** | **Case 18** | **Case 19** | **Case 20** | **Case 21** | **Case 22** |
| X | 150 | 200 | 200 | 200 | 300 | 300 | 300 | 50 |
| Bandwidth | 100M | 20M | 40M | 100M | 20M | 40M | 100M | 20M |
| Link type | All link | All link | All link | All link | All link | All link | All link | LOS only |
| **Parameters** | **Case 23** | **Case 24** | **Case 25** | **Case 26** | **Case 27** | **Case 28** | **Case 29** | **Case 30** |
| X | 50 | 50 | 150 | 150 | 150 | 300 | 300 | 300 |
| Bandwidth | 40M | 100M | 20M | 40M | 100M | 20M | 40M | 100M |
| Link type | LOS only | LOS only | LOS only | LOS only | LOS only | LOS only | LOS only | LOS only |

Evaluation cases for urban grid scenarios for V2X use cases are provided in Table B.1.7.1-4 and Table B.1.7.1-5.

**Table B.1.7.1-4: Assumptions for sidelink positioning in urban grid scenarios for V2X use cases that are different from or not provided in Annex A.1 from [24]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | **Case 31** | **Case 32** | **Case 33** | **Case 34** | **Case 35** | **Case 36** |
| Anchor nodes | Joint | Joint | Joint | SL only | SL only | SL only |
| Bandwidth | 100MHz | 40MHz | 20MHz | 100MHz | 40MHz | 20MHz |

**Table B.1.7.1-5: Assumptions for sidelink positioning in urban grid scenarios for V2X use cases that are different from or not provided in Annex A.1 from [24]**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | **Case 37** | **Case 38** | **Case 39** | **Case 40** | **Case 41** | **Case 42** | **Case 43** | **Case 44** |
| X | 20 | 20 | 20 | 30 | 30 | 30 | 50 | 50 |
| Bandwidth | 20M | 40M | 100M | 20M | 40M | 100M | 20M | 40M |
| **Parameters** | **Case 45** | **Case 46** | **Case 47** | **Case 48** | **Case 49** | **Case 50** | **Case 51** |
| X | 50 | 80 | 80 | 80 | 150 | 150 | 150 |
| Bandwidth | 100M | 20M | 40M | 100M | 20M | 40M | 100M |

Evaluation cases for IIoT use cases with InF-SH scenario are provided in Table B.1.7.1-6 and Table B.1.7.1-7. Evaluation cases for IIoT use cases with InF-DH scenario are provided in Table B.1.7.1-8 and Table B.1.7.1-9.

**B.1.7.1-6: Assumptions for sidelink positioning for IIoT use cases with InF-SH scenario that are different from or not provided in Annex A.1 from [24]**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | **Case 52** | | **Case 53** | | **Case 54** | | | **Case 55** | | **Case 56** | | | **Case 57** | |
| Anchor nodes | SL only | | SL only | | SL only | | | SL only | | SL only | | | SL only | |
| Bandwidth | 20MHz | | 20MHz | | 40MHz | | | 40MHz | | 100MHz | | | 100MHz | |
| Anchor UEs number | 10 | | 20 | | 10 | | | 20 | | 10 | | | 20 | |
| **Parameters** | **Case 58** | **Case 59** | | **Case 60** | | **Case 61** | **Case 62** | | **Case 63** | | **Case 64** | **Case 65** | | **Case 66** |
| Anchor nodes | Uu only | SL only | | Joint | | Uu only | SL only | | Joint | | Uu only | SL only | | Joint |
| Bandwidth | 20M | 20M | | 20M | | 40M | 40M | | 40M | | 100M | 100M | | 100M |
| Anchor UEs number | 10 | 10 | | 10 | | 10 | 10 | | 10 | | 10 | 10 | | 10 |

**B.1.7.1-7: Assumptions for sidelink positioning for IIoT use cases with InF-SH scenario that are different from or not provided in Annex A.1 from [24]**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | **Case 67** | **Case 68** | | **Case 69** | | **Case 70** | | **Case 71** | **Case 72** | **Case 73** | **Case 74** | **Case 75** |
| X | 10 | 20 | | 30 | | 50 | | 10 | 20 | 30 | 50 | 10 |
| Bandwidth | 20M | 20M | | 20M | | 20M | | 40M | 40M | 40M | 40M | 100M |
| **Parameters** | **Case 76** | | **Case 77** | | **Case 78** | |
| X | 20 | | 30 | | 50 | |
| Bandwidth | 100MHz | | 100MHz | | 100MHz | |

**B.1.7.1-8: Assumptions for sidelink positioning for IIoT use cases with InF-DH scenario that are different from or not provided in Annex A.1 from [24]**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | | **Case 79** | | **Case 80** | | **Case 81** | | | **Case 82** | | **Case 83** | | | **Case 84** | |
| Anchor nodes | | SL only | | SL only | | SL only | | | SL only | | SL only | | | SL only | |
| Bandwidth | | 20MHz | | 20MHz | | 40MHz | | | 40MHz | | 100MHz | | | 100MHz | |
| Anchor UEs number | | 10 | | 20 | | 10 | | | 20 | | 10 | | | 20 | |
| **Parameters** | **Case 85** | | **Case 86** | | **Case 87** | | **Case 88** | **Case 89** | | **Case 90** | | **Case 91** | **Case 92** | | **Case 93** |
| Anchor nodes | Uu only | | SL only | | Joint | | Uu only | SL only | | Joint | | Uu only | SL only | | Joint |
| Bandwidth | 20M | | 20M | | 20M | | 40M | 40M | | 40M | | 100M | 100M | | 100M |
| Anchor UEs number | 20 | | 20 | | 20 | | 20 | 20 | | 20 | | 20 | 20 | | 20 |

**B.1.7.1-9: Assumptions for sidelink positioning for IIoT use cases with InF-SH scenario that are different from or not provided in Annex A.1 from [24]**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | **Case 94** | **Case 95** | | **Case 96** | | **Case 97** | | **Case 98** | **Case 99** | **Case 100** | **Case 101** | **Case 102** |
| X | 10 | 20 | | 30 | | 50 | | 10 | 20 | 30 | 50 | 10 |
| Bandwidth | 20Mz | 20M | | 20M | | 20M | | 40M | 40M | 40M | 40M | 100M |
| **Parameters** | **Case 103** | | **Case 104** | | **Case 105** | |
| X | 20 | | 30 | | 50 | |
| Bandwidth | 100M | | 100M | | 100M | |

Evaluation cases and relevant additional assumptions for public safety use cases are provided in Table B.1.7.1-10 and Table B.1.7.1-11.

**Table B.1.7.1-10: Assumptions for sidelink positioning for public safety use cases that are different from or not provided in Annex A.1 from [24]**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| BS location | 7 macro sites with 3 cells per site | | | | | | | | | | | |
| UE drop | Antenna height 1.5m, speed 3km/h, uniformly and randomly distributed at the macro geographical area | | | | | | | | | | | |
| Reference UE | Anchor UEs per cell are dropped randomly | | | | | | | | | | | |
| SL channel model | Modify RMa described in TR 38.901, i.e. replace BS with the reference UE in the channel model of BS2UE, where reference UE height, transmit power are used to replace gNB’s. | | | | | | | | | | | |
| Uu channel model | RMa described in TR 38.901 | | | | | | | | | | | |
| **Parameters** | **Case 106** | | **Case 107** | | **Case 108** | | **Case 109** | | **Case 110** | | **Case 111** | |
| Anchor nodes | SL only | | SL only | | SL only | | SL only | | SL only | | SL only | |
| Bandwidth | 20MHz | | 20MHz | | 40MHz | | 40MHz | | 100MHz | | 100MHz | |
| Anchor UEs number | 1 per cell | | 2 per cell | | 1 per cell | | 2 per cell | | 1 per cell | | 2 per cell | |
| **Parameters** | **Case 112** | **Case 113** | | **Case 114** | **Case 115** | **Case 116** | | **Case 117** | **Case 118** | **Case 119** | | **Case 120** |
| Anchor nodes | Uu only | SL only | | Joint | Uu only | SL only | | Joint | Uu only | SL only | | Joint |
| Bandwidth | 20M | 20M | | 20M | 40M | 40M | | 40M | 100M | 100M | | 100M |
| Anchor UEs number | 2 per cell | 2 per cell | | 2 per cell | 2 per cell | 2 per cell | | 2 per cell | 2 per cell | 2 per cell | | 2 per cell |

**Table B.1.7.1-11: Assumptions for sidelink positioning for public safety use cases that are different from or not provided in Annex A.1 from [24]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | **Case 121** | **Case 122** | **Case 123** | **Case 124** | **Case 125** | **Case 126** |
| X | 50 | 100 | 50 | 100 | 50 | 100 |
| Bandwidth | 20MHz | 20MHz | 40MHz | 40MHz | 100MHz | 100MHz |

Evaluation cases and relevant additional assumptions for commercial use cases are provided in Table B.1.7.1-12 and Table B.1.7.1-13.

**B.1.7.1-12: Assumptions for sidelink positioning for commercial use cases that are different from or not provided in Annex A.1 from [24]**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| BS location | 12 sites deployed as described in TR 38.901 | | | | | | | | | | | |
| UE drop | Antenna height 1.5m, speed 3km/h, uniformly and randomly distributed at the macro geographical area | | | | | | | | | | | |
| Reference UE | Anchor UEs are dropped randomly | | | | | | | | | | | |
| SL channel model | Modify indoor office channel model described in TR 38.901, i.e. replace BS with the reference UE in the channel model of BS2UE, where reference UE height, transmit power are used to replace gNB’s. | | | | | | | | | | | |
| Uu channel model | Indoor office described in TR 38.901 | | | | | | | | | | | |
| **Parameters** | **Case 127** | | **Case 128** | | **Case 129** | | **Case 130** | | **Case 131** | | **Case 132** | |
| Anchor nodes | SL only | | SL only | | SL only | | SL only | | SL only | | SL only | |
| Bandwidth | 20MHz | | 40MHz | | 100MHz | | 20MHz | | 40MHz | | 100MHz | |
| Anchor UEs number | 6 | | 12 | | 6 | | 12 | | 6 | | 12 | |
| **Parameters** | **Case 133** | **Case 134** | | **Case 135** | **Case 136** | **Case 137** | | **Case 138** | **Case 139** | **Case 140** | | **Case 141** |
| Anchor nodes | Uu only | SL only | | Joint | Uu only | SL only | | Joint | Uu only | SL only | | Joint |
| Bandwidth | 20M | 20M | | 20M | 40M | 40M | | 40M | 100M | 100M | | 100M |
| Anchor UEs number | 12 | 12 | | 12 | 12 | 12 | | 12 | 12 | 12 | | 12 |

**B.1.7.1-13: Assumptions for sidelink positioning for commercial use cases that are different from or not provided in Annex A.1 from [24]**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | **Case 142** | **Case 143** | **Case 144** | **Case 145** | **Case 146** | **Case 147** | **Case 148** | **Case 149** | **Case 150** |
| X | 10 | 20 | 50 | 10 | 20 | 50 | 10 | 20 | 50 |
| Bandwidth | 20M | 20M | 20M | 40M | 40M | 40M | 100M | 100M | 100M |

B.1.7.2 Positioning accuracy evaluation results for Sidelink Positioning

This subsection provides evaluation results for sidelink positioning, including absolute positioning and relative positioning, in V2X use case with highway scenario and urban grid scenario, IIOT use case, public safety use case and commercial use case.

B.1.7.2.1 Positioning accuracy evaluation results for Sidelink Positioning for Highway Scenarios for V2X

Table B.1.7.2.1-1 provides horizontal absolute positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.7.2.1-2 provides vertical absolute positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.7.X.2.1-3 provides horizontal relative positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.7.2.1-4 provides ranging distance accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.7.2.1-5 provides ranging angle accuracy results using sidelink positioning for highway scenarios for V2X use cases.

**Table B.1.7.2.1-1: Sidelink positioning - horizontal absolute accuracy for highway scenarios for V2X use cases from [24]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of Set A**  **(If not, which percentile satisfies)** | **Whether meet the requirement of Set B**  **(If not, which percentile satisfies)** |
| Case 1-Joint, BW=100MHz | 0.111 | 0.1505 | 0.1861 | 0.2169 | Yes | Yes |
| Case 2-Joint, BW=40MHz | 0.3517 | 0.4583 | 0.6207 | 0.7354 | Yes | No  67% |
| Case 3-Joint, BW=20MHz | 0.6651 | 0.8498 | 1.104 | 1.287 | Yes | No  Less than 50% |
| Case 4-SL only, BW=100MHz | 0.2397 | 0.3952 | 0.5869 | 0.8348 | Yes | No  67% |
| Case 5-SL only, BW=40MHz | 0.6787 | 1.02 | 1.412 | 2.343 | No  80% | No  Less than 50% |
| Case 6-SL only, BW=20MHz | 1.013 | 1.542 | 2.405 | 3.08 | No  50% | No  Less than 50% |

**Table B.1.7.2.1-2: Sidelink positioning - vertical absolute accuracy for highway scenarios for V2X use cases from [24]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of Set A**  **(If not, which percentile satisfies)** | **Whether meet the requirement of Set B**  **(If not, which percentile satisfies)** |
| Case 1-Joint, BW=100MHz | 0.784 | 1.193 | 1.445 | 1.578 | Yes | Yes |
| Case 2-Joint, BW=40MHz | 1.423 | 1.57 | 2.965 | 4.481 | No  80% | No  67% |
| Case 3-Joint, BW=20MHz | 2.725 | 7.534 | 9.946 | 12.76 | No  50% | No  Less than 50% |
| Case 4-SL only, BW=100MHz | 7.236 | 8.714 | 9.927 | 11.81 | No  Less than 50% | No  Less than 50% |
| Case 5-SL only, BW=40MHz | 9.216 | 10.73 | 12.47 | 14.64 | No  Less than 50% | No  Less than 50% |
| Case 6-SL only, BW=20MHz | 12.12 | 14.2 | 17.62 | 23.06 | No  Less than 50% | No  Less than 50% |

**Table B.7.X.2.1-3: Sidelink positioning - horizontal relative accuracy for highway scenarios for V2X use cases from [24]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of Set A**  **(If not, which percentile satisfies)** | **Whether meet the requirement of Set B**  **(If not, which percentile satisfies)** |
| Case 22, X=50m, BW=20M | 1.05 | 1.714 | 2.56 | 3.601 | No  50% | No  Less than 50% |
| Case 23, X=50m, BW=40M | 0.7736 | 1.159 | 1.556 | 2.273 | No  67% | No  Less than 50% |
| Case 24, X=50m, BW=100M | 0.4851 | 0.7523 | 1.042 | 1.46 | Yes | No  50% |
| Case 25, X=150m, BW=20M | 1.83 | 2.992 | 4.922 | 8.784 | No  Less than 50% | No  Less than 50% |
| Case 26, X=150m, BW=40M | 1.383 | 2.399 | 3.93 | 6.74 | No  50% | No  Less than 50% |
| Case 27, X=150m, BW=100M | 0.8476 | 1.366 | 2.005 | 4.133 | No  67% | No  Less than 50% |
| Case 28, X=300m, BW=20M | 2.971 | 5.61 | 10.29 | 23.81 | No  Less than 50% | No  Less than 50% |
| Case 29, X=300m, BW=40M | 2.502 | 4.672 | 7.724 | 17.3 | No  Less than 50% | No  Less than 50% |
| Case 30, X=300m, BW=100M | 1.607 | 2.978 | 5.662 | 14.31 | No  Less than 50% | No  Less than 50% |

**Table B.1.7.2.1-4: Sidelink positioning - ranging distance accuracy for highway scenarios for V2X use cases from [24]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of Set A**  **(If not, which percentile satisfies)** | **Whether meet the requirement of Set B**  **(If not, which percentile satisfies)** |
| Case 7, X=50m, BW=20M | 0.3994 | 0.5319 | 0.7112 | 1.085 | Yes | No  50% |
| Case 8, X=50m, BW=40M | 0.1995 | 0.2837 | 0.3862 | 0.5556 | Yes | No  80% |
| Case 9, X=50m, BW=100M | 0.1127 | 0.1628 | 0.2354 | 0.3442 | Yes | Yes |
| Case 10, X=100m, BW=20M | 0.4145 | 0.5466 | 0.8197 | 1.173 | Yes | No  50% |
| Case 11, X=100m, BW=40M | 0.2075 | 0.2909 | 0.4125 | 0.6223 | Yes | No  80% |
| Case 12, X=100m, BW=100M | 0.1112 | 0.1611 | 0.2239 | 0.3187 | Yes | Yes |
| Case 13, X=150m, BW=20M | 0.4109 | 0.5499 | 0.7665 | 1.165 | Yes | No  50% |
| Case 14, X=150m, BW=40M | 0.2097 | 0.2945 | 0.4125 | 0.6555 | Yes | No  80% |
| Case 15, X=150m, BW=100M | 0.1149 | 0.1658 | 0.2477 | 0.3885 | Yes | Yes |
| Case 16, X=200m, BW=20M | 0.4129 | 0.5541 | 0.7826 | 1.191 | Yes | No  50% |
| Case 17, X=200m, BW=40M | 0.2124 | 0.2984 | 0.4185 | 0.6714 | Yes | No  80% |
| Case 18, X=200m, BW=100M | 0.1185 | 0.1722 | 0.2522 | 0.4 | Yes | Yes |
| Case 19, X=300m, BW=20M | 0.4134 | 0.5575 | 0.804 | 1.229 | Yes | No  50% |
| Case 20, X=300m, BW=40M | 0.2284 | 0.3285 | 0.4564 | 0.7286 | Yes | No  80% |
| Case 21, X=300m, BW=100M | 0.1202 | 0.1739 | 0.2572 | 0.4299 | Yes | Yes |

**Table B.1.7.2.1-5: Sidelink positioning - ranging angle accuracy for highway scenarios for V2X use cases from [24]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of Set A**  **(If not, which percentile satisfies)** | **Whether meet the requirement of Set B**  **(If not, which percentile satisfies)** |
| Case 22, X=50m, BW=20M | 1.446 | 2.34 | 3.594 | 6.16 | Yes | Yes |
| Case 23, X=50m, BW=40M | 0.9293 | 1.63 | 2.914 | 5.078 | Yes | Yes |
| Case 24, X=50m, BW=100M | 0.6204 | 1.258 | 1.881 | 3.838 | Yes | Yes |
| Case 25, X=150m, BW=20M | 1.123 | 1.73 | 3.168 | 4.488 | Yes | Yes |
| Case 26, X=150m, BW=40M | 0.941 | 1.419 | 2.358 | 4.842 | Yes | Yes |
| Case 27, X=150m, BW=100M | 0.5651 | 1.08 | 1.647 | 3.835 | Yes | Yes |
| Case 28, X=300m, BW=20M | 1.143 | 1.818 | 3.204 | 5.01 | Yes | Yes |
| Case 29, X=300m, BW=40M | 0.941 | 1.402 | 2.436 | 4.711 | Yes | Yes |
| Case 30, X=300m, BW=100M | 0.657 | 1.029 | 1.586 | 3.306 | Yes | Yes |

B.1.7.2.2 Positioning accuracy evaluation results for Sidelink Positioning for Urban Grid Scenarios for V2X

Table B.1.7.2.2-1 provides horizontal absolute positioning accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.7.2.2-2 provides ranging distance accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

**Table B.1.7.2.2-1: Sidelink positioning - horizontal absolute accuracy for urban grid scenarios for V2X use cases from [24]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of Set A**  **(If not, which percentile satisfies)** | **Whether meet the requirement of Set B**  **(If not, which percentile satisfies)** |
| Case 31-Joint, BW=100MHz | 0.1718 | 0.226 | 0.2865 | 0.3423 | Yes | Yes |
| Case 32-Joint, BW=40MHz | 0.6298 | 0.9333 | 1.325 | 1.918 | No  80% | No  Less than 50% |
| Case 33-Joint, BW=20MHz | 1.038 | 1.368 | 1.772 | 2.247 | No  67% | No  Less than 50% |
| Case 34-SL only, BW=100MHz | 1.764 | 3.569 | 6.164 | 8.403 | No  Less than 50% | No  Less than 50% |
| Case 35-SL only, BW=40MHz | 6.644 | 8.542 | 10.95 | 13.28 | No  Less than 50% | No  Less than 50% |
| Case 36-SL only, BW=20MHz | 7.035 | 9.373 | 12.75 | 16.08 | No  Less than 50% | No  Less than 50% |

**Table B.1.7.2.2-2: Sidelink positioning - ranging distance accuracy for urban grid scenarios for V2X use cases from [24]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of Set A**  **(If not, which percentile satisfies)** | **Whether meet the requirement of Set B**  **(If not, which percentile satisfies)** |
| Case 37, X=20m, BW=20M | 0.6843 | 1.067 | 1.667 | 2.298 | No  67% | No  Less than 50% |
| Case 38, X=20m, BW=40M | 0.3272 | 0.5479 | 0.7734 | 1.014 | Yes | No  50% of UEs |
| Case 39, X=20m, BW=100M | 0.3272 | 0.2898 | 0.3934 | 0.6417 | Yes | No  80% |
| Case 40, X=30m, BW=20M | 0.7525 | 1.151 | 1.785 | 2.782 | No  67% | No  Less than 50% |
| Case 41, X=30m, BW=40M | 0.3559 | 0.5654 | 0.8703 | 1.413 | Yes | No  50% |
| Case 42, X=30m, BW=100M | 0.1813 | 0.2942 | 0.444 | 0.752 | Yes | No  80% |
| Case 43, X=50m, BW=20M | 0.8824 | 1.484 | 2.312 | 4.622 | No  67% | No  Less than 50% |
| Case 44, X=50m, BW=40M | 0.4467 | 0.752 | 1.11 | 2.59 | No  80% | No  50% |
| Case 45, X=50m, BW=100M | 0.2034 | 0.3642 | 0.6787 | 2.143 | No  80% | No  67% |
| Case 46, X=80m, BW=20M | 1.007 | 1.714 | 3.042 | 6.949 | No  50% | No  Less than 50% |
| Case 47, X=80m, BW=40M | 0.4828 | 0.8532 | 1.587 | 6.793 | No  67% | No  50% |
| Case 48, X=80m, BW=100M | 0.2277 | 0.444 | 1.019 | 5.43 | No  80% | No  67% |
| Case 49, X=150m, BW=20M | 1.121 | 1.977 | 3.634 | 8.883 | No  50% | No  Less than 50% |
| Case 50, X=150m, BW=40M | 0.5553 | 1.016 | 2.296 | 8.547 | No  67% | No  Less than 50% |
| Case 51, X=150m, BW=100M | 0.2902 | 0.5964 | 2.033 | 7.251 | No  67% | No  50% |

B.1.7.2.3 Positioning accuracy evaluation results for Sidelink Positioning for IIoT

Table B.1.7.2.3-1 provides horizontal absolute positioning accuracy results using sidelink positioning for IIoT use cases with InF-SH scenario.

Table B.1.7.2.3-2 provides ranging distance accuracy results using sidelink positioning for IIoT use cases with InF-SH scenario.

Table B.1.7.2.3-3 provides horizontal absolute positioning accuracy results using sidelink positioning for IIoT use cases with InF-DH scenario.

Table B.1.7.2.3-4 provides ranging distance accuracy results using sidelink positioning for IIoT use cases with InF-DH scenario.

**Table B.1.7.2.3-1 Sidelink positioning - horizontal absolute accuracy for IIoT use cases with InF-SH scenario from [24]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of Set A**  **(If not, which percentile satisfies)** | **Whether meet the requirement of Set B**  **(If not, which percentile satisfies)** |
| Case 52-SL only, 10 anchors, BW=20MHz | 0.9601 | 1.257 | 1.769 | 2.585 | No  50% | No  Less than 50% |
| Case 53-SL only, 20 anchors, BW=20MHz | 0.7325 | 0.9754 | 1.181 | 1.5 | No  67% | No  Less than 50% |
| Case 54-SL only, 10 anchors, BW=40MHz | 0.4576 | 0.6031 | 0.8316 | 1.441 | No  80% | No  Less than 50% |
| Case 55-SL only, 20 anchors, BW=40MHz | 0.3471 | 0.4425 | 0.5702 | 0.7137 | Yes | No  Less than 50% |
| Case 56-SL only, 10 anchors, BW=100MHz | 0.2021 | 0.2768 | 0.3797 | 0.4717 | Yes | No  Less than 50% |
| Case 57-SL only, 20 anchors, BW=100MHz | 0.1395 | 0.1943 | 0.2329 | 0.3127 | Yes | No  67% |
| Case 58-Uu only, BW=20MHz | 1.689 | 2.125 | 2.519 | 3.105 | No  Less than 50% | No  Less than 50% |
| Case 59-SL only, BW=20MHz | 0.9601 | 1.257 | 1.769 | 2.585 | No  50% | No  Less than 50% |
| Case 60-Joint, BW=20MHz | 0.9462 | 1.317 | 1.802 | 2.148 | No  50% | No  Less than 50% |
| Case 61-Uu only, BW=40MHz | 0.736 | 1.034 | 1.264 | 1.668 | No  50% | No  Less than 50% |
| Case 62-SL only, BW=40MHz | 0.4576 | 0.6031 | 0.8484 | 1.441 | No  80% | No  Less than 50% |
| Case 63-Joint, BW=40MHz | 0.4545 | 0.6321 | 0.8158 | 1.107 | No  80% | No  Less than 50% |
| Case 64-Uu only, BW=100MHz | 0.2249 | 0.3048 | 0.3759 | 0.5133 | Yes | No  Less than 50% |
| Case 65-SL only, BW=100MHz | 0.2021 | 0.2768 | 0.3797 | 0.4717 | Yes | No  Less than 50% |
| Case 66-Joint, BW=100MHz | 0.166 | 0.2153 | 0.2783 | 0.3212 | Yes | No  50% |

**Table B.1.7.2.3-2: Sidelink positioning - ranging distance accuracy for IIoT use cases with InF-SH scenario from [24]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of Set A**  **(If not, which percentile satisfies)** | **Whether meet the requirement of Set B**  **(If not, which percentile satisfies)** |
| Case 67, X=10m, BW=20M | 0.6901 | 1.0826 | 1.6368 | 2.4109 | No  50% | No  Less than 50% |
| Case 68, X=20m, BW=20M | 0.7135 | 1.148 | 1.833 | 2.6936 | No  50% | No  Less than 50% |
| Case 69, X=30m, BW=20M | 0.7062 | 1.1722 | 1.718 | 2.641 | No  50% | No  Less than 50% |
| Case 70, X=50m, BW=20M | 0.7262 | 1.184 | 1.785 | 2.87 | No  50% | No  Less than 50% |
| Case 71, X=10m, BW=40M | 0.3274 | 0.5224 | 0.7726 | 1.1595 | No  80% | No  Less than 50% |
| Case 72, X=20m, BW=40M | 0.3692 | 0.5666 | 0.8597 | 1.271 | No  80% | No  Less than 50% |
| Case 73, X=30m, BW=40M | 0.3548 | 0.568 | 0.8629 | 1.295 | No  80% | No  Less than 50% |
| Case 74, X=50m, BW=40M | 0.3572 | 0.5733 | 0.8861 | 1.481 | No  80% | No  Less than 50% |
| Case 75, X=10m, BW=100M | 0.1389 | 0.22 | 0.311 | 0.4912 | Yes | No  50% |
| Case 76, X=20m, BW=100M | 0.1312 | 0.2014 | 0.2813 | 0.4246 | Yes | No  50% |
| Case 77, X=30m, BW=100M | 0.1386 | 0.2107 | 0.3083 | 0.4573 | Yes | No  50% |
| Case 78, X=50m, BW=100M | 0.1491 | 0.2277 | 0.3257 | 0.5206 | Yes | No  50% |

**Table B.1.7.2.3-3: Sidelink positioning - horizontal absolute accuracy for IIoT use cases with InF-DH scenario from [24]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of Set A**  **(If not, which percentile satisfies)** | **Whether meet the requirement of Set B**  **(If not, which percentile satisfies)** |
| Case 79-SL only, 10 anchors, BW=20MHz | 1.7 | 2.843 | 4.824 | 9.196 | No  Less than 50% | No  Less than 50% |
| Case 80-SL only, 20 anchors, BW=20MHz | 1.093 | 1.551 | 2.185 | 3.566 | No  Less than 50% | No  Less than 50% |
| Case 81-SL only, 10 anchors, BW=40MHz | 0.8144 | 2.004 | 3.857 | 7.081 | No  50% | No  Less than 50% |
| Case 82-SL only, 20 anchors, BW=40MHz | 0.5264 | 0.8396 | 1.547 | 2.808 | No  67% | No  Less than 50% |
| Case 83-SL only, 10 anchors, BW=100MHz | 0.3465 | 0.5537 | 1.368 | 2.694 | No  67% | No  Less than 50% |
| Case 84-SL only, 20 anchors, BW=100MHz | 0.1928 | 0.2337 | 0.3022 | 0.5069 | Yes | No  50% |
| Case 85-Uu only, BW=20MHz | 1.993 | 2.794 | 3.866 | 5.483 | No  Less than 50% | No  Less than 50% |
| Case 86-SL only, BW=20MHz | 1.093 | 1.551 | 2.185 | 3.566 | No  Less than 50% | No  Less than 50% |
| Case 87-Joint, BW=20MHz | 1.249 | 1.717 | 2.096 | 2.715 | No  Less than 50% | No  Less than 50% |
| Case 88-Uu only, BW=40MHz | 1.066 | 1.602 | 2.629 | 3.355 | No  Less than 50% | No  Less than 50% |
| Case 89-SL only, BW=40MHz | 0.5385 | 0.8396 | 1.547 | 2.808 | No  67% | No  Less than 50% |
| Case 90-Joint, BW=40MHz | 0.5339 | 0.7756 | 0.9745 | 1.992 | No  80% | No  Less than 50% |
| Case 91-Uu only, BW=100MHz | 0.2865 | 0.4146 | 0.7936 | 1.343 | No  80% | No  Less than 50% |
| Case 92-SL only, BW=100MHz | 0.1982 | 0.2337 | 0.2897 | 0.5001 | Yes | No  50% |
| Case 93-Joint, BW=100MHz | 0.1696 | 0.2227 | 0.2779 | 0.3723 | Yes | No  50% |

**Table B.1.7.2.3-4: Sidelink positioning - ranging distance accuracy for IIoT use cases with InF-SH scenario from [24]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of Set A**  **(If not, which percentile satisfies)** | **Whether meet the requirement of Set B**  **(If not, which percentile satisfies)** |
| Case 94, X=10m, BW=20M | 0.7768 | 1.2700 | 2.0104 | 3.4948 | No  50% | No  Less than 50% |
| Case 95, X=20m, BW=20M | 0.9037 | 1.5404 | 2.8503 | 5.5656 | No  50% | No  Less than 50% |
| Case 96, X=30m, BW=20M | 1.0253 | 1.8831 | 3.6125 | 7.3011 | No  Less than 50% | No  Less than 50% |
| Case 97, X=50m, BW=20M | 1.2797 | 2.5698 | 5.0680 | 9.4485 | No  Less than 50% | No  Less than 50% |
| Case 98, X=10m, BW=40M | 0.3506 | 0.5868 | 0.9964 | 2.0758 | No  80% | No  Less than 50% |
| Case 99, X=20m, BW=40M | 0.4286 | 0.8030 | 1.7002 | 4.6739 | No  67% | No  Less than 50% |
| Case 100, X=30m, BW=40M | 0.5100 | 1.1154 | 2.8696 | 6.1450 | No  50% | No  Less than 50% |
| Case 101, X=50m, BW=40M | 0.7062 | 1.8874 | 4.3185 | 7.6209 | No  50% | No  Less than 50% |
| Case 102, X=10m, BW=100M | 0.1573 | 0.2395 | 0.3922 | 0.8593 | Yes | No  50% |
| Case 103, X=20m, BW=100M | 0.1827 | 0.3171 | 0.6684 | 2.2383 | No  80% | No  50 |
| Case 104, X=30m, BW=100M | 0.2136 | 0.4181 | 1.2540 | 3.5309 | No  67% | No  Less than 50% |
| Case 105, X=50m, BW100M | 0.2833 | 0.7670 | 2.2663 | 5.4863 | No  67% | No  Less than 50% |

B.1.7.2.4 Positioning accuracy evaluation results for Sidelink Positioning for Public Safety

Table B.1.7.2.4-1 provides horizontal absolute positioning accuracy results using sidelink positioning for public safety use cases.

Table B.1.7.2.4-2 provides ranging distance accuracy results using sidelink positioning for public safety use cases.

**Table B.1.7.2.4-1: Sidelink positioning - horizontal absolute accuracy for public safety use cases from [24]**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement**  **(If not, which percentile satisfies)** |
| Case 106-SL only, 1AnchorPerCell, BW=20MHz | 1.2431 | 1.6627 | 2.2263 | 2.7782 | No  Less than 50% |
| Case 107-SL only, 2AnchorPerCell, BW=20MHz | 1.1540 | 1.3990 | 1.8544 | 2.4199 | No  Less than 50% |
| Case 108-SL only, 1AnchorPerCell, BW=40MHz | 0.6223 | 0.8382 | 1.0678 | 1.4093 | No  67% |
| Case 109-SL only, 2AnchorPerCell, BW=40MHz | 0.5020 | 0.6966 | 0.9116 | 1.1534 | No  67% |
| Case 110-SL only, 1AnchorPerCell, BW=100MHz | 0.1845 | 0.2370 | 0.3186 | 0.4217 | Yes |
| Case 111-SL only, 2AnchorPerCell, BW=100MHz | 0.1879 | 0.2430 | 0.3133 | 0.3791 | Yes |
| Case 112-Uu only, BW=20MHz | 1.8009 | 2.7300 | 3.8247 | 5.2236 | No  Less than 50% |
| Case 113-SL only, BW=20MHz | 1.2431 | 1.6627 | 2.2263 | 2.7782 | No  Less than 50% |
| Case 114-Joint, BW=20MHz | 1.1896 | 1.5632 | 1.8704 | 2.4784 | No  Less than 50% |
| Case 115-Uu only, BW=40MHz | 0.9407 | 1.2932 | 2.0182 | 3.7831 | No  50% |
| Case 116-SL only, BW=40MHz | 0.6223 | 0.8382 | 1.0678 | 1.4093 | No  67% |
| Case 117-Joint, BW=40MHz | 0.5413 | 0.6843 | 0.9032 | 1.2951 | No  80% |
| Case 118-Uu only, BW=100MHz | 0.2451 | 0.3440 | 0.5354 | 1.1024 | No  80% |
| Case 119-SL only, BW=100MHz | 0.1845 | 0.2370 | 0.3186 | 0.4217 | Yes |
| Case 120-Joint, BW=100MHz | 0.1553 | 0.2006 | 0.2371 | 0.3215 | Yes |

**Table B.1.7.2.4-2: Sidelink positioning - ranging distance accuracy for public safety use cases from [24]**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement**  **(If not, which percentile satisfies)** |
| Case 121, X=50m, BW=20M | 0.9619 | 1.5115 | 2.2571 | 3.4623 | No  50% |
| Case 122, X=100m, BW=20M | 1.0451 | 1.6282 | 2.4441 | 3.6152 | No  Less than 50% |
| Case 123, X=50m, BW=40M | 0.4199 | 0.7328 | 0.9629 | 1.5160 | No  80% |
| Case 124, X=100m, BW=40M | 0.5146 | 0.8310 | 1.1884 | 1.9188 | No  67% |
| Case 125, X=50m, BW=100M | 0.1744 | 0.2644 | 0.3564 | 0.5212 | Yes |
| Case 126, X=100m, BW=100M | 0.2001 | 0.3020 | 0.4339 | 0.6977 | Yes |

B.1.7.2.5 Positioning accuracy evaluation results for Sidelink Positioning for Commercial use cases

Table B.1.7.2.5-1 provides horizontal absolute positioning accuracy results using sidelink positioning for commercial use cases.

Table B.1.7.2.5-2 provides ranging distance accuracy results using sidelink positioning for commercial use cases.

**Table B.1.7.2.5-1: Sidelink positioning - horizontal absolute accuracy for commercial use cases from [24]**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement**  **(If not, which percentile satisfies)** |
| Case 127-SL only, 6 anchors, BW=20MHz | 2.1461 | 3.2026 | 4.6755 | 8.6156 | No  Less than 50% |
| Case 128-SL only, 12 anchors, BW=20MHz | 1.0610 | 1.4826 | 2.1985 | 3.6284 | No  Less than 50% |
| Case 129-SL only, 6 anchors, BW=40MHz | 1.0987 | 1.9727 | 3.4794 | 6.2018 | No  Less than 50% |
| Case 130-SL only, 12 anchors, BW=40MHz | 0.5389 | 0.7543 | 1.1236 | 1.8774 | No  67% |
| Case 131-SL only, 6 anchors, BW=100MHz | 0.4717 | 1.0361 | 2.3075 | 3.8034 | No  50% |
| Case 132-SL only, 12 anchors, BW=100MHz | 0.2095 | 0.2888 | 0.3851 | 0.6686 | Yes |
| Case 133-Uu only, BW=20MHz | 2.1720 | 3.4177 | 5.3990 | 8.7723 | No  Less than 50% |
| Case 134-SL only, BW=20MHz | 1.0610 | 1.4826 | 2.1985 | 3.6284 | No  Less than 50% |
| Case 135-Joint, BW=20MHz | 0.8773 | 1.2925 | 1.9244 | 3.1375 | No  50% |
| Case 136-Uu only, BW=40MHz | 1.2981 | 2.3471 | 4.0848 | 6.8611 | No  Less than 50% |
| Case 137-SL only, BW=40MHz | 0.5389 | 0.7543 | 1.1236 | 1.8774 | No  67% |
| Case 138-Joint, BW=40MHz | 0.5420 | 0.7834 | 1.0244 | 1.6111 | No  67% |
| Case 139-Uu only, BW=100MHz | 0.3256 | 0.4614 | 0.7002 | 1.1877 | No  80% |
| Case 140-SL only, BW=100MHz | 0.2095 | 0.2888 | 0.3851 | 0.6686 | Yes |
| Case 141-Joint, BW=100MHz | 0.1797 | 0.2360 | 0.3077 | 0.4194 | Yes |

**Table B.1.7.2.5-2: Sidelink positioning - ranging distance accuracy for commercial use cases from [ZTE, CMCC]**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement**  **(If not, which percentile satisfies)** |
| Case 142, X=10m, BW=20M | 0.6704 | 1.0351 | 1.4676 | 2.3429 | No  50% |
| Case 143, X=20m, BW=20M | 0.7335 | 1.1849 | 2.0779 | 4.4369 | No  50% |
| Case 144, X=50m, BW=20M | 1.0277 | 1.8600 | 3.5915 | 7.4588 | No  Less than 50% |
| Case 145, X=10m, BW=40M | 0.3234 | 0.5564 | 0.8593 | 1.3219 | No  80% |
| Case 146, X=20m, BW=40M | 0.3983 | 0.6566 | 1.0717 | 2.2932 | No  67% |
| Case 147, X=50m, BW=40M | 0.5044 | 1.0035 | 2.4196 | 5.8426 | No  50% |
| Case 148, X=10m, BW=100M | 0.1622 | 0.2465 | 0.3483 | 0.5100 | Yes |
| Case 149, X=20m, BW=100M | 0.1657 | 0.2518 | 0.4139 | 1.0946 | No  80% |
| Case 150, X=50m, BW=100M | 0.2142 | 0.4080 | 1.1495 | 3.4859 | No  67% |

B.1.8 Results from source [25]

B.1.8.1 Description of evaluation scenarios

The detailed evaluation assumptions of V2X urban scenario are listed in Table B.1.8.1-1.

**Table B.1.8.1-1: evaluation assumptions for V2X urban scenario**

|  |  |
| --- | --- |
| **Parameter** |  |
| Carrier frequency | 6GHz |
| Subcarrier spacing | 30KHz |
| Reference Signal Transmission Bandwidth | 20MHz, 40MHz, 100MHz |
| Reference Signal Physical Structure and Resource Allocation (RE pattern) | DL PRS, comb 2, 2 symbols |
| Reference signal including PRS, SRS and SL-PRS  (type of sequence, number of ports, …) | SL-PRS |
| Number of symbols used per occasion | 2 |
| number of occasions used per positioning estimate | 1 |
| Power-boosting level | No |
| Uplink power control (applied/not applied) | Not applied |
| interference modelling (ideal muting, or other) | Ideal muting |
| Description of Measurement Algorithm (e.g., super resolution, interference cancellation, ….) | MUSIC |
| Description of positioning technique / applied positioning algorithm (e.g., Least square, Taylor series, etc) | Single side RTT  AoA |
| Synchronization assumptions | Perfect synchronization |
| UE antenna model | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1), dH=dV=0.5λ  Optional: (M, N, P, Mg, Ng) = (1, 4, 2, 1, 1) for AoA |

For commercial use case, the indoor office scenario defined in TR 38. 855 is used. UEs are uniformly distributed in the 120m \* 50m area.“Channel models” specified in Section A.2.1.2 of TR 36.843 is reused with parameters modified by what is specified in TR 38.901, as shown in Table B.1.8.1-2.

**Table B.1.8.1-2. Indoor UE-to-UE channel model used for commercial use case**

|  |  |  |
| --- | --- | --- |
|  | **TR 36.843 section A.2.1.2** | **With parameters modified by specified in TR 38.901** |
| **Pathloss** | **PLLOS(R)= 89.5 + 16.9log10(R)**  **PLNLOS(R)= 147.4+43.3log10(R)**  **For 2GHz, R in km** | **LOS:**    **NLOS:** |
| **LOS prob.** |  |  |
| **Shadowing STD** | **LOS: 3dB, NLOS: 4dB** | **LOS: 3dB, NLOS 8.03dB** |
| **Fast fading** | **ITU-R IMT InH** | **Section 7.5 in TR 38.901** |

The evaluation assumptions for commercial use case are listed in table B.1.8.1-3.

**Table B.1.8.1-3. Evaluation assumptions for commercial use case**

|  |  |
| --- | --- |
| **Parameter** |  |
| Carrier frequency | 4GHz |
| Subcarrier spacing | 30KHz |
| Reference Signal Transmission Bandwidth | 20MHz, 40MHz, 100MHz |
| Reference Signal Physical Structure and Resource Allocation (RE pattern) | DL PRS, comb 2, 2 symbols |
| Reference signal including PRS, SRS and SL-PRS  (type of sequence, number of ports, …) | SL-PRS |
| Number of symbols used per occasion | 2 |
| number of occasions used per positioning estimate | 1 |
| Power-boosting level | No |
| Uplink power control (applied/not applied) | No |
| interference modelling (ideal muting, or other) | Ideal muting |
| Description of Measurement Algorithm (e.g., super resolution, interference cancellation, ….) | MUSIC |
| Description of positioning technique / applied positioning algorithm (e.g., Least square, Taylor series, etc) | Single side RTT |
| Synchronization assumptions | Perfect synchronization |
| UE antenna model | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1), dH=dV=0.5λ |

B.1.8.2 Positioning accuracy evaluation results for Ranging/SL positioning

B.1.8.2.1 Positioning accuracy evaluation results for Sidelink Positioning for Urban Grid Scenarios for V2X

Table B.1.8.2.1-1 provides ranging distance accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.8.2.1-2 provides ranging direction accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

**Table B.1.8.2.1-1. Ranging distance accuracy with different SL PRS bandwidth and Max. distance**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Distance Accuracy (meter) | | | | Requirements | |
| 50% percentile | 67% percentile | 80% percentile | 90% percentile | Set A (1.5m) | Set B (0.5m) |
| Case 1: X = 20m, BW = 20MHz | 0.4189 | 0.6667 | 1.0532 | 2.0399 | No,  85.47% | No,  55.79% |
| Case 2: X = 20m, BW = 40MHz | 0.1572 | 0.254 | 0.4051 | 0.7432 | Yes | No  84.83% |
| Case 3: X = 20m, BW = 100MHz | 0.0298 | 0.0453 | 0.0688 | 0.1489 | Yes | Yes |
| Case 4: X = 50m, BW = 20MHz | 0.5122 | 0.8317 | 1.2108 | 2.0597 | No,  84.1% | No  48.74% |
| Case 5: X = 50m, BW = 40MHz | 0.1784 | 0.3062 | 0.4683 | 0.8145 | Yes | No  81.87% |
| Case 6: X = 50m, BW = 100MHz | 0.0321 | 0.0518 | 0.0919 | 0.1946 | Yes | Yes |
| Case 7: X = 100m, BW = 20MHz | 0.6233 | 0.979 | 1.7008 | 2.6354 | No  76.82% | No  43.24% |
| Case 8: X = 100m, BW = 40MHz | 0.2165 | 0.3649 | 0.624 | 1.1268 | Yes | No  75.33% |
| Case 9: X = 100m, BW = 100MHz | 0.0406 | 0.0824 | 0.1358 | 0.247 | Yes | Yes |

**Table** **B.1.8.2.1-2. Ranging horizontal direction accuracy with 2 receiving antennas**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Distance Accuracy (meter) | | | | Requirements | |
| 50% percentile | 67% percentile | 80% percentile | 90% percentile | Set A (±15°) | Set B (±8°) |
| Case 1: X = 20m, BW = 20MHz, 2 RX antennas | 8.0201 | 14.5349 | 22.2378 | 28.5592 | No  68.2% | No  49.1% |
| Case 2: X = 20m, BW = 40MHz, 2 RX antennas | 8.2587 | 13.0733 | 17.8458 | 23.2033 | No  75.5% | No  47.3% |
| Case 3: X = 20m, BW = 100MHz, 2 RX antennas | 5.0556 | 10.1155 | 14.6209 | 18.4429 | No  82.7% | No  58.2% |
| Case 4: X = 50m, BW = 20MHz, 2 RX antennas | 10.0173 | 16.4313 | 22.6808 | 28.4135 | No  65.3% | No  37.9% |
| Case 5: X = 50m, BW = 40MHz, 2 RX antennas | 9.433 | 14.5363 | 19.4506 | 26.38 | No  67.8% | No  41.7% |
| Case 6: X = 50m, BW = 100MHz, 2 RX antennas | 6.1632 | 11.2265 | 17.4709 | 22.3776 | No  74.2% | No  57.3% |
| Case 7: X = 100m, BW = 20MHz, 2 RX antennas | 12.1816 | 17.4512 | 22.0971 | 28.8933 | No  61.3% | No  37.1% |
| Case 8: X = 100m, BW = 40MHz, 2 RX antennas | 10.3217 | 15.9011 | 20.2306 | 26.9232 | No  61.2% | No  40.8% |
| Case 9: X = 100m, BW = 100MHz, 2 RX antennas | 6.8388 | 10.138 | 18.7711 | 25.6619 | No  76.5% | No  60.2% |
| Case 10: X = 20m, BW = 20MHz, 4 RX antennas | 1.54 | 2.8624 | 5.8825 | 14.5541 | Yes | No  83.64% |
| Case 11: X = 20m, BW = 40MHz, 4 RX antennas | 1.1 | 2.5235 | 6.3216 | 13.2869 | Yes | No  81.82% |
| Case 12: X = 20m, BW = 100MHz, 4 RX antennas | 0.6181 | 1.369 | 3.6688 | 7.9956 | Yes | Yes |
| Case 13: X = 50m, BW = 20MHz, 4 RX antennas | 1.7061 | 4.2044 | 9.2234 | 15.3433 | No  89.52% | No  75.81% |
| Case 14: X = 50m, BW = 40MHz, 4 RX antennas | 1.3967 | 3.3272 | 6.1323 | 14.0921 | Yes | No  81.51% |
| Case 15: X = 50m, BW = 100MHz, 4 RX antennas | 0.9762 | 1.6711 | 7.3003 | 11.0581 | Yes | No  83.87% |
| Case 16: X = 100m, BW = 20MHz, 4 RX antennas | 2.0205 | 4.5539 | 9.4126 | 16.1609 | No  88.79% | No  74.14% |
| Case 17: X = 100m, BW = 40MHz, 4 RX antennas | 1.4129 | 4.4715 | 9.7085 | 14.3184 | Yes | No  75.86% |
| Case 18: X = 100m, BW = 100MHz, 4 RX antennas | 1.0131 | 2.0244 | 6.9331 | 11.4785 | Yes | No  83.87% |

B.1.8.2.2 Ranging distance evaluation results for Sidelink Positioning for commercial use cases

Table B.1.8.2.2-1 provides ranging distance accuracy results using sidelink positioning for commercial use cases.

**Table B.1.8.2.2-1. Ranging distance accuracy with different SL PRS bandwidth and Max. distance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Distance Accuracy (meter) | | | | Requirements |
| 50% percentile | 67% percentile | 80% percentile | 90% percentile | 1m | |
| Case 19: X = 10m, BW = 20MHz | 0.2096 | 0.4146 | 0.6239 | 0.9838 | Yes | |
| Case 20: X = 10m, BW = 40MHz | 0.0738 | 0.1312 | 0.2223 | 0.3903 | Yes | |
| Case 21: X = 10m, BW = 100MHz | 0.0188 | 0.0273 | 0.0360 | 0.0483 | Yes | |
| Case 22: X = 20m, BW = 20MHz | 0.3279 | 0.5223 | 0.7348 | 1.1644 | No  85.34% | |
| Case 23: X = 20m, BW = 40MHz | 0.0834 | 0.1519 | 0.2542 | 0.4667 | Yes | |
| Case 24: X = 20m, BW = 100MHz | 0.0263 | 0.0358 | 0.0626 | 0.1071 | Yes | |
| Case 25: X = 50m, BW = 20MHz | 0.3389 | 0.5242 | 1.0483 | 4.6341 | No  76.67% | |
| Case 26: X = 50m, BW = 40MHz | 0.1142 | 0.2002 | 0.6463 | 1.5786 | No  86.67% | |
| Case 27: X = 50m, BW = 100MHz | 0.0295 | 0.0500 | 0.1681 | 0.3140 | Yes | |

B.1.9 Results from source [26]

B.1.9.1 Description of evaluation scenarios

The evaluation assumptions for SL positioning performance for V2X scenarios are presented in this sub-section. The scope of the evaluations focuses on the SL positioning performance for 2 sub-scenarios within the V2X use case including Highway and Urban Grid scenarios.

The common simulation assumptions for all evaluated V2X scenarios are summarized in Table B.1.9.1-1. Additional simulations for each of the evaluated cases are also shown in Table B.1.9.1-2 and Table B.1.9.1-3.

**Table B.1.9.1-1 Common assumption for all scenarios if they are different from or not specified in Agreements**

|  |  |
| --- | --- |
| **Parameter** | **Value/Description** |
| Carrier frequency | 6 GHz |
| Subcarrier spacing | 30 kHz |
| Reference Signal Transmission Bandwidth | 20/40/100 MHz |
| Reference Signal Physical Structure and Resource Allocation (RE pattern) | Comb-4 |
| Reference signal including PRS, SRS and SL-PRS  (type of sequence, number of ports, …) | DL-PRS (Gold Sequence) |
| Number of symbols used per occasion | 4 symbols |
| Number of occasions used per positioning estimate | 1 |
| Power-boosting level | 3 dB |
| Uplink power control (applied/not applied) | Not applied |
| Interference modelling (ideal muting, or other) | None |
| Description of Measurement Algorithm (e.g. super resolution, interference cancellation, ….) | MUSIC for timing-based techniques  ESPIRIT for angle-based techniques |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | Least Squares |
| Synchronization assumptions | Ideal/Perfect Synchronization |
| UE/gNB RX and TX timing error assumption | No timing/calibration error |
| Additional notes, if any | Channel Model: LOS plus NLOSv CDL model as described in Section 6.2 of [TR37.885, 5]  BS-type RSU Tx power: 23 dBm  UE receiver noise figure: 9 dB  UE Dropping: Random, Option A in [TR37.885, 5] |

**Table B.1.9.1-2 Simulation Assumptions for V2X – Highway**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameters** | **Case 1** | **Case 2** | **Case 3** | **Case 4** |
| **UE Antenna model** | Baseline: (1, 2, 2, 1, 1)  Optional: (1, 4, 2, 1, 1) | Baseline: (1, 2, 2, 1, 1) | Baseline: (1, 2, 2, 1, 1) | Baseline: (1, 2, 2, 1, 1) |
| **TRP antenna model** | Baseline: (1, 2, 2, 1, 1)  Optional: (1, 4, 2, 1, 1) | Baseline: (1, 2, 2, 1, 1) | Baseline: (1, 2, 2, 1, 1) | Baseline: (1, 2, 2, 1, 1) |
| **BS/RSU deployment for absolute positioning** | Baseline: Ustaggered (See Figure 2) | Baseline: Unstaggered Optional: Staggered  (See Figure 2) | Baseline: Unstaggered  Optional: Staggered  (See Figure 2) | Baseline: Unstaggered  Optional: Staggered  (See Figure 2) |
| **BS/RSU deployment for relative positioning/ranging** | Baseline:Unstaggered  (See Figure 2) | Baseline: Unstaggered  (See Figure 2) | Baseline: Unstaggered  (See Figure 2) | Baseline: Unstaggered  (See Figure 2) |
| **Selected values of X (relative positioning or ranging is performed between two UEs within X m)** | Xmax=100 m | Xmax=100 m | Xmax=100 m | Xmax={25 m, 50 m, 100 m} |
| **Positioning method** | SL-AoA | SL-TDoA | SL-RTT (single-sided and double-sided) | SL-RTT+SL-AoA |

**Table B.1.9.1-3 Simulation Assumptions for V2X – Urban Grid**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameters** | **Case 1** | **Case 2** | **Case 3** | **Case 4** |
| **UE Antenna model** | Baseline: (1, 2, 2, 1, 1)  Optional: (1, 4, 2, 1, 1) | Baseline: (1, 2, 2, 1, 1) | Baseline: (1, 2, 2, 1, 1) | Baseline: (1, 2, 2, 1, 1) |
| **TRP antenna model** | Baseline: (1, 2, 2, 1, 1)  Optional: (1, 4, 2, 1, 1) | Baseline: (1, 2, 2, 1, 1) | Baseline: (1, 2, 2, 1, 1) | Baseline: (1, 2, 2, 1, 1) |
| **BS/RSU deployment for absolute positioning** | As described in TR37.885 for Urban Grid | As described in TR37.885 for Urban Grid | As described in TR37.885 for Urban Grid | As described in TR37.885 for Urban Grid |
| **BS/RSU deployment for relative positioning/ranging** | As described in TR37.885 for Urban Grid | As described in TR37.885 for Urban Grid | As described in TR37.885 for Urban Grid | As described in TR37.885 for Urban Grid |
| **Selected values of X (relative positioning or ranging is performed between two UEs within X m)** | Xmax=100 m | Xmax=100 m | Xmax=100 m | Xmax=50 m |
| **Positioning method** | SL-AoA | SL-TDoA | SL-RTT (single-sided and double-sided) | SL-RTT+SL-AoA |

B.1.9.2 Positioning accuracy evaluation results for Sidelink Positioning

This subsection provides the evaluation results for sidelink positioning, which includes absolute horizontal positioning, ranging for direction, ranging for distance and relative horizontal positioning, for V2X use cases consisting of both highway and urban grid scenarios.

B.1.9.2.1 Positioning accuracy evaluation results for Sidelink Positioning for a Highway Scenario for V2X

Table B.1.9.2.1-1 provides horizontal absolute positioning accuracy results using sidelink positioning for highway scenarios using the two anchor SL-AoA method.

Table B.1.9.2.1-2 provides ranging angle accuracy results using sidelink positioning for highway scenarios for V2X use cases using the two SL-AoA method.

Table B. 1.9.2.1-3 provides horizontal absolute positioning accuracy results using sidelink positioning for highway scenarios using the SL-TDoA method.

Table B.1.9.2.1-4 provides ranging distance accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.9.2.1-5 provides horizontal relative positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Please note that the case descriptions correspond to the results presented in [26].

**Table B.1.9.2.1-1 Simulation results for highway for absolute positioning - horizontal accuracy using the two Anchors SL-AOA method**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meets the requirement of set A (1.5 m for 90% of UEs)** | **Whether meets the requirement of set B (0.5 m for 90% of UEs)** |
| **Case #1-1**: BW#20MHz, FR#1, Baseline Ant. Config., positioning method #SL-AOA, No. of Anchors#2 | 50.3674 | 78.2740 | 131.4805 | 359.6720 | No, < 2% | No, < 1% |
| **Case #1-2**: BW#20MHz, FR#1, Optional Ant. Config., positioning method #SL-AOA, No. of Anchors#2 | 31.9281 | 50.3661 | 81.0170 | 190.7552 | No, < 4% | No, < 1% |

**Table B.1.9.2.1-2 Simulation results for highway for ranging positioning - mean angle accuracy using the two Anchors SL-AOA method**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meets the requirement of set A (±15° for 90% of the UEs)** | **Whether meets the requirement of set B (±8° for 90% of the UEs)** |
| **Case #1-3**: BW#20MHz, FR#1, Baseline Ant. Config., positioning method #SL-AOA, No. of Anchors#2 | 1.2723 | 1.8783 | 2.6586 | 3.5648 | Yes | Yes |
| **Case #1-4**: BW#20MHz, FR#1, Optional Ant. Config., positioning method #SL-AOA, No. of Anchors#2 | 0.8000 | 1.2532 | 2.0338 | 3.3655 | Yes | Yes |

**Table B.1.9.2.1-3 Simulation results for highway for absolute positioning - horizontal accuracy using the SL-TDoA method**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A (1.5 m for 90% of UEs)** | **Whether meet the requirement of set B (0.5 m for 90% of UEs)** |
| **Case #2-1**: BW#100MHz, FR#1, Baseline Ant. Config., positioning method #SL-TDoA, No. of Anchors#4, highway unstaggered | 0.7 | 0.99 | 1.382 | 1.797 | No, 80% | No, 33% |
| **Case #2-2**: BW#40 MHz, FR#1, Baseline Ant. Config., positioning method #SL-TDoA, No. of Anchors#4, highway unstaggered | 1.36 | 2.07 | 2.84 | 3.67 | No, 50% | No, 20% |
| **Case #2-3**: BW#20 MHz, FR#1, Baseline Ant. Config., positioning method #SL-TDoA, No. of Anchors#4, highway unstaggered | 1.68 | 2.59 | 3.5 | 4.57 | No, 44% | No, 15% |
| **Case #2-4**: BW#100MHz, FR#1, Baseline Ant. Config., positioning method #SL-TDoA, No. of Anchors#4, highway staggered | 0.49 | 0.649 | 1.059 | 1.413 | Yes | No, 50% |
| **Case #2-5**: BW#40 MHz, FR#1, Baseline Ant. Config., positioning method #SL-TDoA, No. of Anchors#4, highway staggered | 1.224 | 1.92 | 2.611 | 3.45 | No, 50% | No, 18% |
| **Case #2-6**: BW#20 MHz, FR#1, Baseline Ant. Config., positioning method #SL-TDoA, No. of Anchors#4, highway staggered | 1.566 | 2.42 | 3.31 | 4.301 | No, 46% | No, 15% |

**Table B.1.9.2.1-4 Simulation results for highway for ranging - distance accuracy**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A (1.5 m for 90% of UEs)** | **Whether meet the requirement of set B (0.5 m for 90% of UEs)** |
| **Case #3-1**: BW#100 MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided), No. of Anchors#1 | 0.49 | 0.74 | 0.963 | 1.23 | Yes | No, 50% |
| **Case #3-2**: BW#20MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided), No. of Anchors#1 | 0.86 | 1.25 | 1.7 | 2.2 | No, 70% | No, less than 50% |
| **Case #3-3**: BW#100 MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Double-sided), No. of Anchors#1 | 0.35 | 0.5 | 0.67 | 0.83 | Yes | No, 67% |

**Table B.1.9.2.1-5 Simulation results for highway for relative positioning - horizontal accuracy**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A (1.5 m for 90% of UEs)** | **Whether meet the requirement of set B (0.5 m for 90% of UEs)** |
| **Case #4-1**: BW#20MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided)+AOA, No. of Anchors#1  Xmax = 100 m | 0.668 | 1.064 | 1.607 | 2.35 | No, 70% | No, less than 50% |
| **Case #4-2**: BW#100 MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided)+AOA, No. of Anchors#1  Xmax = 100 m | 0.39 | 0.6059 | 0.937 | 1.4715 | Yes | No, 60% |
| **Case #4-3**: BW#20MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided)+AOA, No. of Anchors#1  Xmax = 50 m | 0.437 | 0.701 | 1.005 | 1.62 | No, 84% | No, 50% |
| **Case #4-4**: BW#100 MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided)+AOA, No. of Anchors#1  Xmax = 50 m | 0.231 | 0.375 | 0.591 | 0.862 | Yes | No, 60% |
| **Case #4-5**: BW#20MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided)+AOA, No. of Anchors#1  Xmax = 25 m | 0.228 | 0.37 | 0.8 | 1.08 | Yes | No, 70% |
| **Case #4-6**: BW#100MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided)+AOA, No. of Anchors#1  Xmax = 25 m | 0.144 | 0.229 | 0.339 | 0.45 | Yes | Yes |

B.1.9.2.2 Positioning accuracy evaluation results for Sidelink Positioning for a Urban Grid Scenario for V2X

Table B.1.9.2.2-1 provides horizontal absolute positioning accuracy results using sidelink positioning for urban grid scenarios using the two anchor SL-AoA method.

Table B.1.9.2.2-2 provides ranging angle accuracy results using sidelink positioning for urban grid scenarios for V2X use cases using the two SL-AoA method.

Table B. 1.9.2.2-3 provides horizontal absolute positioning accuracy results using sidelink positioning for urban grid scenarios using the SL-TDoA method.

Table B.1.9.2.2-4 provides ranging distance accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.9.2.2-5 provides horizontal relative positioning accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.9.2.2-6 provides ranging angle accuracy results using sidelink positioning for urban grid scenarios for V2X use cases using the SL-RTT+SL-AOA case.

Please note that the case descriptions correspond to the results presented in [26].

**Table B.1.9.2.2-1 Simulation results for urban grid for absolute positioning - horizontal accuracy using the two Anchors SL-AOA method**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meets the requirement of set A (1.5 m for 90% of UEs)** | **Whether meets the requirement of set B (0.5 m for 90% of UEs)** |
| **Case #1-5**: BW#20MHz, FR#1, Baseline Ant. Config., positioning method #SL-AOA, No. of Anchors#2 | 50.5270 | 94.7376 | 175.7269 | 354.6127 | No, < 2% | No, < 1% |
| **Case #1-6**: BW#20MHz, FR#1, Optional Ant. Config., positioning method #SL-AOA, No. of Anchors#2 | 27.2999 | 40.8991 | 62.0999 | 116.9959 | No, < 2% | No, < 1% |

**Table B.1.9.2.2-2 Simulation results for urban grid for ranging positioning - mean angle accuracy using the two Anchors SL-AOA method**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A (±15° for 90% of the UEs)** | **Whether meet the requirement of set B (±8° for 90% of the UEs)** |
| **Case #1-7:** BW#20MHz, FR#1, Baseline Ant. Config., positioning method #SL-AOA, No. of Anchors#2 | 0.8455 | 1.2397 | 1.6140 | 2.2050 | Yes | Yes |
| **Case #1-8**: BW#20MHz, FR#1, Optional Ant. Config., positioning method #SL-AOA, No. of Anchors#2 | 0.4343 | 0.5556 | 0.7053 | 0.8853 | Yes | Yes |

**Table B.1.9.2.2-3 Simulation results for urban grid for absolute positioning - horizontal accuracy using the SL-TDoA method**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A (1.5 m for 90% of UEs)** | **Whether meet the requirement of set B (0.5 m for 90% of UEs)** |
| **Case #2-7**: BW#100 MHz, FR#1, Baseline Ant. Config., positioning method # SL-TDOA, No. of Anchors#4 | 1.83 | 2.83 | 3.85 | 5.10 | No, 20% | No, 12% |
| **Case #2-8**: BW#40 MHz, FR#1, Baseline Ant. Config., positioning method # SL-TDOA, No. of Anchors#4 | 2.66 | 4.04 | 5.57 | 7.34 | No, 15% | No, 10% |
| **Case #2-9**: BW#20 MHz, FR#1, Baseline Ant. Config., positioning method # SL-TDOA, No. of Anchors#4 | 3.01 | 4.71 | 6.23 | 8.15 | No, 14% | No, 10% |

**Table B.1.9.2.2-4 Simulation results for urban grid for ranging - distance accuracy**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A (1.5 m for 90% of UEs)** | **Whether meet the requirement of set B (0.5 m for 90% of UEs)** |
| **Case #3-4**: BW#100 MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided), No. of Anchors#1 | 0.39 | 0.565 | 0.97 | 0.92 | Yes | No, 60% |
| **Case #3-5**: BW#20MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided), No. of Anchors#1 | 0.52 | 0.75 | 0.97 | 1.29 | Yes | No, less than 50% |

**Table B.1.9.2.2-5 Simulation results for urban grid for relative positioning - horizontal accuracy**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A (1.5 m for 90% of UEs)** | **Whether meet the requirement of set B (0.5 m for 90% of UEs)** |
| **Case #4-7**: BW#20 MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided)+AOA, No. of Anchors#1  Xmax = 100 m | 0.67 | 1.06 | 1.55 | 2.35 | No, 76% | No, less than 50% |
| **Case #4-8**: BW#100 MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided)+AOA, No. of Anchors#1  Xmax = 100 m | 0.38 | 0.56 | 0.86 | 1.24 | Yes | No, 60% |
| **Case #4-9**: BW#20MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided)+AOA, No. of Anchors#1  Xmax = 50 m | 0.389 | 0.605 | 0.937 | 1.4 | Yes | No, 60% |
| **Case #4-10**: BW#100 MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided)+AOA, No. of Anchors#1  Xmax = 50 m | 0.14 | 0.23 | 0.34 | 0.51 | Yes | No, almost |
| **Case #4-11**: BW#20 MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided)+AOA, No. of Anchors#1  Xmax = 25 m | 0.59 | 0.72 | 0.81 | 1.05 | Yes | No, less than 50% |
| **Case #4-12**: BW#100 MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (Single-sided)+AOA, No. of Anchors#1  Xmax = 25 m | 0.133 | 0.202 | 0.3 | 0.38 | Yes | Yes |

**Table B.1.9.2.2-6 Simulation results for urban grid for ranging - angle accuracy**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meets the requirement of set A (±15° for 90% of the UEs)** | **Whether meets the requirement of set B (±8° for 90% of the UEs)** |
| **Case #4-13**: BW#20MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (One-way)+AOA, No. of Anchors#1  Xmax = 100 m | 0.9 | 1.2 | 1.5 | 2.2 | Yes | Yes |
| **Case #4-14**: BW#100MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (One-way)+AOA, No. of Anchors#1  Xmax = 100 m | 0.5 | 0.8 | 1.01 | 1.5 | Yes | Yes |
| **Case #4-15**: BW#20MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (One-way)+AOA, No. of Anchors#1  Xmax = 50 m | 0.9 | 1.32 | 2 | 3 | Yes | Yes |
| **Case #4-16**: BW#100 MHz, FR#1, Baseline Ant. Config., positioning method # SL-RTT (One-way)+AOA, No. of Anchors#1  Xmax = 50 m | 0.61 | 0.9 | 1.2 | 1.9 | Yes | Yes |

B.1.10 Results from source [27]

B.1.10.1 Description of evaluation scenarios

Common assumptions applicable to all evaluated scenarios are provided in Table B.1.10.1-1.

Assumptions for ranging (SL single-RTT) in highway scenarios for V2X use cases are provided in Table B.1.10.1-2 to Table B.1.10.1-5.

Assumptions for absolute positioning (SL multi-RTT) in highway scenarios for V2X use cases are provided in Table B.1.10.1-6 to Table B.1.10.1-9.

Assumptions for absolute positioning (SL TDOA) in highway scenarios for V2X use cases are provided in B.1.10.1-10 to Table B.1.10.1-13.

**Table B.1.10.1-1 Common assumption for all scenarios if they are different from or not specified in Agreements**

|  |  |
| --- | --- |
| **Parameter** |  |
| Carrier frequency | 6 GHz |
| Subcarrier spacing | 60 kHz |
| Reference Signal Transmission Bandwidth | 20MHz, 40 MHz, 100MHz, 400MHz |
| Reference Signal Physical Structure and Resource Allocation (RE pattern) | (comb size, #symbols) = (1,1), (6,6), (12,12) |
| Reference signal including PRS, SRS and SL-PRS  (type of sequence, number of ports, …) | DL PRS |
| Number of symbols used per occasion | (comb size, #symbols) = (1,1), (6,6), (12,12) |
| number of occasions used per positioning estimate | 1 (single shot estimation) |
| Power-boosting level | No power boosting |
| Uplink power control (applied/not applied) | Not relevant |
| interference modelling (ideal muting, or other) | No transmission of data multiplexed with SL PRS  Every UE is always participating in SL positioning |
| Description of Measurement Algorithm (e.g. super resolution, interference cancellation, ….) | Matched filter(MF), MUSIC |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | Chan estimator [1] |
| Synchronization assumptions | Ideal synchronization |
| UE/gNB RX and TX timing error assumption | No timing error |
| Precoding assumptions (codebook, nrof antenna elements used, etc) | No precoding |
| Antenna configuration in FR2 | RSU Antenna configuration (M, N, P, Mg, Ng)=(1, 4, 2, 1, 4) Panel bearing angle: Ω0,1=Ω0,0+90°; Ω0,2=Ω0,0+180°; Ω0,3=Ω0,0+270°; See Table 6.1.4-5 in TR 37.885 for more details Antenna element: see Table 6.1.4-4 in TR 37.885  UE Antenna configuration (M, N, P, Mg, Ng) = (2, 4, 2, 1, 1) See Table 6.1.4-12 in TR 37.885 for more details Antenna element: see Table 6.1.4-11C in TR 37.885 |
| Retransmission | No retransmission, feedback-based retransmission |

**Table B.1.10.1-2 Assumptions for highway for ranging (SL single-RTT)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 2.1 | Case 2.2 | Case 2.3 | Case 2.4 | Case 2.5 | Case 2.6 |
| Positioning method | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT |
| SL PRS comb size | 1 | 1 | 1 | 6 | 6 | 6 |
| SL PRS #symbols | 1 | 1 | 1 | 6 | 6 | 6 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| Selected values of **X** (m) | 80 | 80 | 80 | 80 | 80 | 80 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 2.7 | Case 2.8 | Case 2.9 | Case 2.10 | Case 2.11 | Case 2.12 |
| Positioning method | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT |
| SL PRS comb size | 12 | 12 | 12 | 1 | 1 | 1 |
| SL PRS #symbols | 12 | 12 | 12 | 1 | 1 | 1 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| Selected values of **X** (m) | 80 | 80 | 80 | 160 | 160 | 160 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 2.13 | Case 2.14 | Case 2.15 | Case 2.16 | Case 2.17 | Case 2.18 |
| Positioning method | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT |
| SL PRS comb size | 6 | 6 | 6 | 12 | 12 | 12 |
| SL PRS #symbols | 6 | 6 | 6 | 12 | 12 | 12 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| Selected values of **X** (m) | 160 | 160 | 160 | 160 | 160 | 160 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |

**Table B.1.10.1-3 Assumptions for highway for ranging (SL single-RTT, MUSIC)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 4.1 | Case 4.2 | Case 4.3 | Case 4.4 | Case 4.5 | Case 4.6 |
| Positioning method | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT |
| SL PRS comb size | 1 | 1 | 1 | 6 | 6 | 6 |
| SL PRS #symbols | 1 | 1 | 1 | 6 | 6 | 6 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| Selected values of **X** (m) | 80 | 80 | 80 | 80 | 80 | 80 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 4.7 | Case 4.8 | Case 4.9 | Case 4.10 | Case 4.11 | Case 4.12 |
| Positioning method | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT |
| SL PRS comb size | 12 | 12 | 12 | 1 | 1 | 1 |
| SL PRS #symbols | 12 | 12 | 12 | 1 | 1 | 1 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| Selected values of **X** (m) | 80 | 80 | 80 | 160 | 160 | 160 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 4.13 | Case 4.14 | Case 4.15 | Case 4.16 | Case 4.17 | Case 4.18 |
| Positioning method | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT |
| SL PRS comb size | 6 | 6 | 6 | 12 | 12 | 12 |
| SL PRS #symbols | 6 | 6 | 6 | 12 | 12 | 12 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| Selected values of **X** (m) | 160 | 160 | 160 | 160 | 160 | 160 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |

**Table B.1.10.1-4 Assumptions for highway for ranging (SL single-RTT, MF + feedback-based retransmission (FB-ReTX))**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 6.1 | Case 6.2 | Case 6.3 | Case 6.4 | Case 6.5 | Case 6.6 |
| Positioning method | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT |
| SL PRS comb size | 1 | 1 | 1 | 6 | 6 | 6 |
| SL PRS #symbols | 1 | 1 | 1 | 6 | 6 | 6 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| Selected values of **X** (m) | 80 | 80 | 80 | 80 | 80 | 80 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| **Parameters** | Case 6.7 | Case 6.8 | Case 6.9 | Case 6.10 | Case 6.11 | Case 6.12 |
| Positioning method | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT |
| SL PRS comb size | 12 | 12 | 12 | 1 | 1 | 1 |
| SL PRS #symbols | 12 | 12 | 12 | 1 | 1 | 1 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| Selected values of **X** (m) | 80 | 80 | 80 | 160 | 160 | 160 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| **Parameters** | Case 6.13 | Case 6.14 | Case 6.15 | Case 6.16 | Case 6.17 | Case 6.18 |
| Positioning method | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT |
| SL PRS comb size | 6 | 6 | 6 | 12 | 12 | 12 |
| SL PRS #symbols | 6 | 6 | 6 | 12 | 12 | 12 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| Selected values of **X** (m) | 160 | 160 | 160 | 160 | 160 | 160 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |

**Table B.1.10.1-5 Assumptions for highway for ranging (SL single-RTT, MUSIC + FB-ReTx)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 8.1 | Case 8.2 | Case 8.3 | Case 8.4 | Case 8.5 | Case 8.6 |
| Positioning method | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT |
| SL PRS comb size | 1 | 1 | 1 | 6 | 6 | 6 |
| SL PRS #symbols | 1 | 1 | 1 | 6 | 6 | 6 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| Selected values of **X** (m) | 80 | 80 | 80 | 80 | 80 | 80 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| **Parameters** | Case 8.7 | Case 8.8 | Case 8.9 | Case 8.10 | Case 8.11 | Case 8.12 |
| Positioning method | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT |
| SL PRS comb size | 12 | 12 | 12 | 1 | 1 | 1 |
| SL PRS #symbols | 12 | 12 | 12 | 1 | 1 | 1 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| Selected values of **X** (m) | 80 | 80 | 80 | 160 | 160 | 160 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| **Parameters** | Case 8.13 | Case 8.14 | Case 8.15 | Case 8.16 | Case 8.17 | Case 8.18 |
| Positioning method | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT | SL s-RTT |
| SL PRS comb size | 6 | 6 | 6 | 12 | 12 | 12 |
| SL PRS #symbols | 6 | 6 | 6 | 12 | 12 | 12 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| Selected values of **X** (m) | 160 | 160 | 160 | 160 | 160 | 160 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |

**Table B.1.10.1-6 Assumptions for highway for absolute positioning (SL multi-RTT)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 10.1 | Case 10.2 | Case 10.3 | Case 10.4 | Case 10.5 | Case 10.6 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 1 | 1 | 1 | 1 | 1 | 1 |
| SL PRS #symbols | 1 | 1 | 1 | 1 | 1 | 1 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 3 | 3 | 3 | 3 | 3 | 3 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 10.7 | Case 10.8 | Case 10.9 | Case 10.10 | Case 10.11 | Case 10.12 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 1 | 1 | 1 | 1 | 1 | 1 |
| SL PRS #symbols | 1 | 1 | 1 | 1 | 1 | 1 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 5 | 5 | 5 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 10.13 | Case 10.14 | Case 10.15 | Case 10.16 | Case 10.17 | Case 10.18 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 1 | 1 | 1 | 1 | 1 | 1 |
| SL PRS #symbols | 1 | 1 | 1 | 1 | 1 | 1 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 7 | 7 | 7 | 7 | 7 | 7 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 10.19 | Case 10.20 | Case 10.21 | Case 10.22 | Case 10.23 | Case 10.24 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 6 | 6 | 6 | 6 | 6 | 6 |
| SL PRS #symbols | 6 | 6 | 6 | 6 | 6 | 6 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 3 | 3 | 3 | 3 | 3 | 3 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 10.25 | Case 10.26 | Case 10.27 | Case 10.28 | Case 10.29 | Case 10.30 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 6 | 6 | 6 | 6 | 6 | 6 |
| SL PRS #symbols | 6 | 6 | 6 | 6 | 6 | 6 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 5 | 5 | 5 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 10.31 | Case 10.32 | Case 10.33 | Case 10.34 | Case 10.35 | Case 10.36 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 6 | 6 | 6 | 6 | 6 | 6 |
| SL PRS #symbols | 6 | 6 | 6 | 6 | 6 | 6 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 7 | 7 | 7 | 7 | 7 | 7 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 10.37 | Case 10.38 | Case 10.39 | Case 10.40 | Case 10.41 | Case 10.42 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 12 | 12 | 12 | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 | 12 | 12 | 12 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 3 | 3 | 3 | 3 | 3 | 3 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 10.43 | Case 10.44 | Case 10.45 | Case 10.46 | Case 10.47 | Case 10.48 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 12 | 12 | 12 | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 | 12 | 12 | 12 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 5 | 5 | 5 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 10.49 | Case 10.50 | Case 10.51 | Case 10.52 | Case 10.53 | Case 10.54 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 12 | 12 | 12 | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 | 12 | 12 | 12 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 7 | 7 | 7 | 7 | 7 | 7 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 10.55 | Case 10.56 | Case 10.57 | Case 10.58 | Case 10.59 | Case 10.60 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 1 | 1 | 1 | 6 | 6 | 6 |
| SL PRS #symbols | 1 | 1 | 1 | 6 | 6 | 6 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 3 | 5 | 7 | 3 | 5 | 7 |
| SL PRS BW (MHz) | 400 | 400 | 400 | 400 | 400 | 400 |
| Parameters | Case 10.61 | Case 10.62 | Case 10.63 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 |
| Estimation method | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered |
| # anchor nodes | 3 | 5 | 7 |
| SL PRS BW (MHz) | 400 | 400 | 400 |
| FB-ReTx | disabled | disabled | disabled |

**Table B.1.10.1-7 Assumptions for highway for absolute positioning (SL multi-RTT, MUSIC)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 12.1 | Case 12.2 | Case 12.3 | Case 12.4 | Case 12.5 | Case 12.6 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 1 | 1 | 1 | 1 | 1 | 1 |
| SL PRS #symbols | 1 | 1 | 1 | 1 | 1 | 1 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 3 | 3 | 3 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| Parameters | Case 12.7 | Case 12.8 | Case 12.9 | Case 12.10 | Case 12.11 | Case 12.12 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 1 | 1 | 1 | 6 | 6 | 6 |
| SL PRS #symbols | 1 | 1 | 1 | 6 | 6 | 6 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 7 | 7 | 7 | 3 | 3 | 3 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| Parameters | Case 12.13 | Case 12.14 | Case 12.15 | Case 12.16 | Case 12.17 | Case 12.18 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 6 | 6 | 6 | 6 | 6 | 6 |
| SL PRS #symbols | 6 | 6 | 6 | 6 | 6 | 6 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 5 | 5 | 5 | 7 | 7 | 7 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| Parameters | Case 12.19 | Case 12.20 | Case 12.21 | Case 12.22 | Case 12.23 | Case 12.24 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 12 | 12 | 12 | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 | 12 | 12 | 12 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 3 | 3 | 3 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| Parameters | Case 12.25 | Case 12.26 | Case 12.27 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 |
| Estimation method | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered |
| # anchor nodes | 7 | 7 | 7 |
| SL PRS BW (MHz) | 40 | 100 | 400 |

**Table B.1.10.1-8 Assumptions for highway for absolute positioning (SL multi-RTT, MF+FB-ReTx)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 14.1 | Case 14.2 | Case 14.3 | Case 14.4 | Case 14.5 | Case 14.6 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 1 | 1 | 1 | 1 | 1 | 1 |
| SL PRS #symbols | 1 | 1 | 1 | 1 | 1 | 1 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 3 | 3 | 3 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 14.7 | Case 14.8 | Case 14.9 | Case 14.10 | Case 14.11 | Case 14.12 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 1 | 1 | 1 | 6 | 6 | 6 |
| SL PRS #symbols | 1 | 1 | 1 | 6 | 6 | 6 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 7 | 7 | 7 | 3 | 3 | 3 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 14.13 | Case 14.14 | Case 14.15 | Case 14.16 | Case 14.17 | Case 14.18 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 6 | 6 | 6 | 6 | 6 | 6 |
| SL PRS #symbols | 6 | 6 | 6 | 6 | 6 | 6 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 5 | 5 | 5 | 7 | 7 | 7 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 14.19 | Case 14.20 | Case 14.21 | Case 14.22 | Case 14.23 | Case 14.24 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 12 | 12 | 12 | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 | 12 | 12 | 12 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 3 | 3 | 3 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 14.25 | Case 14.26 | Case 14.27 |  |  |  |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT |  |  |  |
| SL PRS comb size | 12 | 12 | 12 |  |  |  |
| SL PRS #symbols | 12 | 12 | 12 |  |  |  |
| Estimation method | MF | MF | MF |  |  |  |
| RSU deployment | staggered | staggered | staggered |  |  |  |
| # anchor nodes | 7 | 7 | 7 |  |  |  |
| SL PRS BW (MHz) | 40 | 100 | 400 |  |  |  |
| FB-ReTx | enabled | enabled | enabled |  |  |  |

**Table B.1.10.1-9 Assumptions for highway for absolute positioning (SL multi-RTT, MUSIC+FB-ReTx)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 16.1 | Case 16.2 | Case 16.3 | Case 16.4 | Case 16.5 | Case 16.6 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 1 | 1 | 1 | 1 | 1 | 1 |
| SL PRS #symbols | 1 | 1 | 1 | 1 | 1 | 1 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 3 | 3 | 3 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 16.7 | Case 16.8 | Case 16.9 | Case 16.10 | Case 16.11 | Case 16.12 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 1 | 1 | 1 | 6 | 6 | 6 |
| SL PRS #symbols | 1 | 1 | 1 | 6 | 6 | 6 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 7 | 7 | 7 | 3 | 3 | 3 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 16.13 | Case 16.14 | Case 16.15 | Case 16.16 | Case 16.17 | Case 16.18 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 6 | 6 | 6 | 6 | 6 | 6 |
| SL PRS #symbols | 6 | 6 | 6 | 6 | 6 | 6 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 5 | 5 | 5 | 7 | 7 | 7 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 16.19 | Case 16.20 | Case 16.21 | Case 16.22 | Case 16.23 | Case 16.24 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 12 | 12 | 12 | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 | 12 | 12 | 12 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 3 | 3 | 3 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 16.25 | Case 16.26 | Case 16.27 |
| Positioning method | SL m-RTT | SL m-RTT | SL m-RTT |
| SL PRS comb size | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 |
| Estimation method | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered |
| # anchor nodes | 7 | 7 | 7 |
| SL PRS BW (MHz) | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled |

**Table B.1.10.1-10 Assumptions for highway for absolute positioning (SL TDOA)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 18.1 | Case 18.2 | Case 18.3 | Case 18.4 | Case 18.5 | Case 18.6 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 1 | 1 | 1 | 1 | 1 | 1 |
| SL PRS #symbols | 1 | 1 | 1 | 1 | 1 | 1 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 3 | 3 | 3 | 3 | 3 | 3 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 18.7 | Case 18.8 | Case 18.9 | Case 18.10 | Case 18.11 | Case 18.12 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 1 | 1 | 1 | 1 | 1 | 1 |
| SL PRS #symbols | 1 | 1 | 1 | 1 | 1 | 1 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 5 | 5 | 5 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 18.13 | Case 18.14 | Case 18.15 | Case 18.16 | Case 18.17 | Case 18.18 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 1 | 1 | 1 | 1 | 1 | 1 |
| SL PRS #symbols | 1 | 1 | 1 | 1 | 1 | 1 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 7 | 7 | 7 | 7 | 7 | 7 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 18.19 | Case 18.20 | Case 18.21 | Case 18.22 | Case 18.23 | Case 18.24 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 6 | 6 | 6 | 6 | 6 | 6 |
| SL PRS #symbols | 6 | 6 | 6 | 6 | 6 | 6 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 3 | 3 | 3 | 3 | 3 | 3 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 18.25 | Case 18.26 | Case 18.27 | Case 18.28 | Case 18.29 | Case 18.30 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 6 | 6 | 6 | 6 | 6 | 6 |
| SL PRS #symbols | 6 | 6 | 6 | 6 | 6 | 6 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 5 | 5 | 5 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 18.31 | Case 18.32 | Case 18.33 | Case 18.34 | Case 18.35 | Case 18.36 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 6 | 6 | 6 | 6 | 6 | 6 |
| SL PRS #symbols | 6 | 6 | 6 | 6 | 6 | 6 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 7 | 7 | 7 | 7 | 7 | 7 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 18.37 | Case 18.38 | Case 18.39 | Case 18.40 | Case 18.41 | Case 18.42 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 12 | 12 | 12 | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 | 12 | 12 | 12 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 3 | 3 | 3 | 3 | 3 | 3 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 18.43 | Case 18.44 | Case 18.45 | Case 18.46 | Case 18.47 | Case 18.48 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 12 | 12 | 12 | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 | 12 | 12 | 12 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 5 | 5 | 5 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 18.49 | Case 18.50 | Case 18.51 | Case 18.52 | Case 18.53 | Case 18.54 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 12 | 12 | 12 | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 | 12 | 12 | 12 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | symmetric | symmetric | symmetric |
| # anchor nodes | 7 | 7 | 7 | 7 | 7 | 7 |
| SL PRS BW (MHz) | 20 | 40 | 100 | 20 | 40 | 100 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| **Parameters** | Case 18.55 | Case 18.56 | Case 18.57 | Case 18.58 | Case 18.59 | Case 18.60 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 1 | 1 | 1 | 6 | 6 | 6 |
| SL PRS #symbols | 1 | 1 | 1 | 6 | 6 | 6 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 3 | 5 | 7 | 3 | 5 | 7 |
| SL PRS BW (MHz) | 400 | 400 | 400 | 400 | 400 | 400 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| Parameters | Case 18.61 | Case 18.62 | Case 18.63 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 |
| Estimation method | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered |
| # anchor nodes | 3 | 5 | 7 |
| SL PRS BW (MHz) | 400 | 400 | 400 |
| FB-ReTx | disabled | disabled | disabled |
| FB-ReTx | disabled | disabled | disabled |

**Table B.1.10.1-11 Assumptions for highway for absolute positioning (SL-TDOA, MUSIC)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 20.1 | Case 20.2 | Case 20.3 | Case 20.4 | Case 20.5 | Case 20.6 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 1 | 1 | 1 | 1 | 1 | 1 |
| SL PRS #symbols | 1 | 1 | 1 | 1 | 1 | 1 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 3 | 3 | 3 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| Parameters | Case 20.7 | Case 20.8 | Case 20.9 | Case 20.10 | Case 20.11 | Case 20.12 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 1 | 1 | 1 | 6 | 6 | 6 |
| SL PRS #symbols | 1 | 1 | 1 | 6 | 6 | 6 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 7 | 7 | 7 | 3 | 3 | 3 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| Parameters | Case 20.13 | Case 20.14 | Case 20.15 | Case 20.16 | Case 20.17 | Case 20.18 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 6 | 6 | 6 | 6 | 6 | 6 |
| SL PRS #symbols | 6 | 6 | 6 | 6 | 6 | 6 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 5 | 5 | 5 | 7 | 7 | 7 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| Parameters | Case 20.19 | Case 20.20 | Case 20.21 | Case 20.22 | Case 20.23 | Case 20.24 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 12 | 12 | 12 | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 | 12 | 12 | 12 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 3 | 3 | 3 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| FB-ReTx | disabled | disabled | disabled | disabled | disabled | disabled |
| Parameters | Case 20.25 | Case 20.26 | Case 20.27 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 |
| Estimation method | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered |
| # anchor nodes | 7 | 7 | 7 |
| SL PRS BW (MHz) | 40 | 100 | 400 |
| FB-ReTx | disabled | disabled | disabled |

**Table B.1.10.1-12 Assumptions for highway for absolute positioning (SL-TDOA, MF+FB-ReTx)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 22.1 | Case 22.2 | Case 22.3 | Case 22.4 | Case 22.5 | Case 22.6 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 1 | 1 | 1 | 1 | 1 | 1 |
| SL PRS #symbols | 1 | 1 | 1 | 1 | 1 | 1 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 3 | 3 | 3 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 22.7 | Case 22.8 | Case 22.9 | Case 22.10 | Case 22.11 | Case 22.12 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 1 | 1 | 1 | 6 | 6 | 6 |
| SL PRS #symbols | 1 | 1 | 1 | 6 | 6 | 6 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 7 | 7 | 7 | 3 | 3 | 3 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 22.13 | Case 22.14 | Case 22.15 | Case 22.16 | Case 22.17 | Case 22.18 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 6 | 6 | 6 | 6 | 6 | 6 |
| SL PRS #symbols | 6 | 6 | 6 | 6 | 6 | 6 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 5 | 5 | 5 | 7 | 7 | 7 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 22.19 | Case 22.20 | Case 22.21 | Case 22.22 | Case 22.23 | Case 22.24 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 12 | 12 | 12 | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 | 12 | 12 | 12 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 3 | 3 | 3 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 22.25 | Case 22.26 | Case 22.27 |  |  |  |
| Positioning method | SL TDOA | SL TDOA | SL TDOA |  |  |  |
| SL PRS comb size | 12 | 12 | 12 |  |  |  |
| SL PRS #symbols | 12 | 12 | 12 |  |  |  |
| Estimation method | MF | MF | MF |  |  |  |
| RSU deployment | staggered | staggered | staggered |  |  |  |
| # anchor nodes | 7 | 7 | 7 |  |  |  |
| SL PRS BW (MHz) | 40 | 100 | 400 |  |  |  |
| FB-ReTx | enabled | enabled | enabled |  |  |  |

**Table B.1.10.1-13 Assumptions for highway for absolute positioning (SL-TDOA, MUSIC+FB-ReTx)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 24.1 | Case 24.2 | Case 24.3 | Case 24.4 | Case 24.5 | Case 24.6 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 1 | 1 | 1 | 1 | 1 | 1 |
| SL PRS #symbols | 1 | 1 | 1 | 1 | 1 | 1 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 3 | 3 | 3 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 24.7 | Case 24.8 | Case 24.9 | Case 24.10 | Case 24.11 | Case 24.12 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 1 | 1 | 1 | 6 | 6 | 6 |
| SL PRS #symbols | 1 | 1 | 1 | 6 | 6 | 6 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 7 | 7 | 7 | 3 | 3 | 3 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 24.13 | Case 24.14 | Case 24.15 | Case 24.16 | Case 24.17 | Case 24.18 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 6 | 6 | 6 | 6 | 6 | 6 |
| SL PRS #symbols | 6 | 6 | 6 | 6 | 6 | 6 |
| Estimation method | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC | MUSIC |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 5 | 5 | 5 | 7 | 7 | 7 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 24.19 | Case 24.20 | Case 24.21 | Case 24.22 | Case 24.23 | Case 24.24 |
| Positioning method | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA | SL TDOA |
| SL PRS comb size | 12 | 12 | 12 | 12 | 12 | 12 |
| SL PRS #symbols | 12 | 12 | 12 | 12 | 12 | 12 |
| Estimation method | MF | MF | MF | MF | MF | MF |
| RSU deployment | staggered | staggered | staggered | staggered | staggered | staggered |
| # anchor nodes | 3 | 3 | 3 | 5 | 5 | 5 |
| SL PRS BW (MHz) | 40 | 100 | 400 | 40 | 100 | 400 |
| FB-ReTx | enabled | enabled | enabled | enabled | enabled | enabled |
| Parameters | Case 24.25 | Case 24.26 | Case 24.27 |  |  |  |
| Positioning method | SL TDOA | SL TDOA | SL TDOA |  |  |  |
| SL PRS comb size | 12 | 12 | 12 |  |  |  |
| SL PRS #symbols | 12 | 12 | 12 |  |  |  |
| Estimation method | MUSIC | MUSIC | MUSIC |  |  |  |
| RSU deployment | staggered | staggered | staggered |  |  |  |
| # anchor nodes | 7 | 7 | 7 |  |  |  |
| SL PRS BW (MHz) | 40 | 100 | 400 |  |  |  |
| FB-ReTx | enabled | enabled | enabled |  |  |  |

B.1.10.2 Positioning accuracy evaluation results for Sidelink Positioning

Simulation results for ranging (SL single-RTT) in highway scenarios for V2X use cases are provided in B.1.10.2.1-1 to Table B.1.10.2.1-4.

Simulation results for absolute positioning (SL multi-RTT) in highway scenarios for V2X use cases are provided in B.1.10.2.2-1 to Table B.1.10.2.2-4.

Simulation results for absolute positioning (SL TDOA) in highway scenarios for V2X use cases are provided in B.1.10.2.3-1 to Table B.1.10.2.3-4.

B.1.10.2.1 Positioning accuracy evaluation results for Sidelink ranging (SL single-RTT) for Highway Scenarios for V2X

Simulation results for ranging (SL single-RTT) in highway scenarios for V2X use cases with matched filter-based estimation and without feedback-based retransmission are provided in Table B.1.10.2.1-1.

Simulation results for ranging (SL single-RTT) in highway scenarios for V2X use cases with MUSCI-based estimation and without feedback-based retransmission are provided in Table B.1.10.2.1-2.

Simulation results for ranging (SL single-RTT) in highway scenarios for V2X use cases with matched filter-based estimation and with feedback-based retransmission are provided in Table B.1.10.2.1-3.

Simulation results for ranging (SL single-RTT) in highway scenarios for V2X use cases with MUSCI-based estimation and with feedback-based retransmission are provided in Table B.1.10.2.1-4.

**Table B.1.10.2.1-1 Simulation results for highway for ranging - distance accuracy (s-RTT)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID & brief description | 50% | 67% | 80% | 90% | Set A req. | Set B req. |
| Case 2.1, s-RTT, BW=20MHz, X=80m | 0.49 | 0.73 | 1.07 | 1.68 | No. 88% | No. 51% |
| Case 2.4, s-RTT, BW=20MHz, X=80m | 0.49 | 0.72 | 1.03 | 1.56 | No. 89% | No. 51% |
| Case 2.7, s-RTT, BW=20MHz, X=80m | 0.50 | 0.75 | 1.06 | 1.61 | No. 89% | No. 50% |
| Case 2.10, s-RTT, BW=20MHz, X=160m | 0.52 | 0.80 | 1.16 | 2.03 | No. 86% | No. 49% |
| Case 2.13, s-RTT, BW=20MHz, X=160m | 0.51 | 0.76 | 1.14 | 1.85 | No. 86% | No. 49% |
| Case 2.16, s-RTT, BW=20MHz, X=160m | 0.51 | 0.78 | 1.14 | 1.89 | No. 86% | No. 49% |
|  |  |  |  |  |  |  |
| Case 2.2, s-RTT, BW=40MHz, X=80m | 0.41 | 0.60 | 0.81 | 1.17 | Yes | No. 59% |
| Case 2.5, s-RTT, BW=40MHz, X=80m | 0.42 | 0.59 | 0.81 | 1.18 | Yes | No. 59% |
| Case 2.8, s-RTT, BW=40MHz, X=80m | 0.43 | 0.61 | 0.84 | 1.17 | Yes | No. 58% |
| Case 2.11, s-RTT, BW=40MHz, X=160m | 0.43 | 0.63 | 0.90 | 1.40 | Yes | No. 56% |
| Case 2.14, s-RTT, BW=40MHz, X=160m | 0.42 | 0.61 | 0.86 | 1.35 | Yes | No. 58% |
| Case 2.17, s-RTT, BW=40MHz, X=160m | 0.44 | 0.64 | 0.89 | 1.43 | Yes | No. 56% |
|  |  |  |  |  |  |  |
| Case 2.3, s-RTT, BW=100MHz, X=80m | 0.34 | 0.45 | 0.56 | 0.72 | Yes | No. 73% |
| Case 2.6, s-RTT, BW=100MHz, X=80m | 0.33 | 0.45 | 0.56 | 0.71 | Yes | No. 74% |
| Case 2.9, s-RTT, BW=100MHz, X=80m | 0.34 | 0.46 | 0.57 | 0.73 | Yes | No. 72% |
| Case 2.12, s-RTT, BW=100MHz, X=160m | 0.34 | 0.46 | 0.58 | 0.84 | Yes | No. 72% |
| Case 2.15, s-RTT, BW=100MHz, X=160m | 0.33 | 0.45 | 0.58 | 0.81 | Yes | No. 72% |
| Case 2.18, s-RTT, BW=100MHz, X=160m | 0.34 | 0.46 | 0.58 | 0.82 | Yes | No. 72% |

**Table B.1.10.2.1-2 Simulation results for highway for ranging - distance accuracy (s-RTT, MUSIC)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID & brief description | 50% | 67% | 80% | 90% | Set A req. | Set B req. |
| Case 4.1, s-RTT, BW=20MHz, X=80m | 0.45 | 0.65 | 0.91 | 1.31 | Yes | No. 54% |
| Case 4.4, s-RTT, BW=20MHz, X=80m | 0.56 | 0.81 | 1.07 | 1.44 | Yes | No. 45% |
| Case 4.7, s-RTT, BW=20MHz, X=80m | 0.42 | 0.62 | 0.85 | 1.20 | Yes | No. 57% |
| Case 4.10, s-RTT, BW=20MHz, X=160m | 0.48 | 0.72 | 1.03 | 1.64 | No. 88% | No. 51% |
| Case 4.13, s-RTT, BW=20MHz, X=160m | 0.61 | 0.89 | 1.23 | 1.83 | No. 85% | No. 42% |
| Case 4.16, s-RTT, BW=20MHz, X=160m | 0.46 | 0.68 | 0.96 | 1.51 | No. 89% | No. 53% |
|  |  |  |  |  |  |  |
| Case 4.2, s-RTT, BW=40MHz, X=80m | 0.39 | 0.57 | 0.76 | 1.07 | Yes | No. 61% |
| Case 4.5, s-RTT, BW=40MHz, X=80m | 0.41 | 0.61 | 0.79 | 1.01 | Yes | No. 58% |
| Case 4.8, s-RTT, BW=40MHz, X=80m | 0.37 | 0.53 | 0.70 | 0.96 | Yes | No. 63% |
| Case 4.11, s-RTT, BW=40MHz, X=160m | 0.42 | 0.60 | 0.83 | 1.25 | Yes | No. 58% |
| Case 4.14, s-RTT, BW=40MHz, X=160m | 0.46 | 0.68 | 0.89 | 1.21 | Yes | No. 53% |
| Case 4.17, s-RTT, BW=40MHz, X=160m | 0.4 | 0.58 | 0.79 | 1.17 | Yes | No. 60% |
|  |  |  |  |  |  |  |
| Case 4.3, s-RTT, BW=100MHz, X=80m | 0.32 | 0.44 | 0.55 | 0.68 | Yes | No. 74% |
| Case 4.6, s-RTT, BW=100MHz, X=80m | 0.31 | 0.43 | 0.54 | 0.66 | Yes | No. 76% |
| Case 4.9, s-RTT, BW=100MHz, X=80m | 0.32 | 0.44 | 0.54 | 0.67 | Yes | No. 75% |
| Case 4.12, s-RTT, BW=100MHz, X=160m | 0.34 | 0.46 | 0.58 | 0.79 | Yes | No. 71% |
| Case 4.15, s-RTT, BW=100MHz, X=160m | 0.33 | 0.46 | 0.59 | 0.74 | Yes | No. 71% |
| Case 4.18, s-RTT, BW=100MHz, X=160m | 0.33 | 0.46 | 0.58 | 0.78 | Yes | No. 71% |

**Table B.1.10.2.1-3 Simulation results for highway for ranging - distance accuracy (s-RTT, MF + FB-ReTx)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID & brief description | 50% | 67% | 80% | 90% | Set A req. | Set B req. |
| Case 6.1, s-RTT, BW=20MHz, X=80m | 0.40 | 0.58 | 0.79 | 1.10 | Yes | No. 59% |
| Case 6.4, s-RTT, BW=20MHz, X=80m | 0.42 | 0.61 | 0.84 | 1.24 | Yes | No. 57% |
| Case 6.7, s-RTT, BW=20MHz, X=80m | 0.42 | 0.61 | 0.83 | 1.17 | Yes | No. 58% |
| Case 6.10, s-RTT, BW=20MHz, X=160m | 0.43 | 0.62 | 0.87 | 1.27 | Yes | No. 56% |
| Case 6.13, s-RTT, BW=20MHz, X=160m | 0.44 | 0.64 | 0.88 | 1.28 | Yes | No. 55% |
| Case 6.16, s-RTT, BW=20MHz, X=160m | 0.45 | 0.66 | 0.91 | 1.35 | Yes | No. 54% |
|  |  |  |  |  |  |  |
| Case 6.2, s-RTT, BW=40MHz, X=80m | 0.36 | 0.52 | 0.68 | 0.93 | Yes | No. 65% |
| Case 6.5, s-RTT, BW=40MHz, X=80m | 0.37 | 0.53 | 0.70 | 0.94 | Yes | No. 64% |
| Case 6.8, s-RTT, BW=40MHz, X=80m | 0.37 | 0.53 | 0.71 | 0.97 | Yes | No. 63% |
| Case 6.11, s-RTT, BW=40MHz, X=160m | 0.39 | 0.56 | 0.74 | 1.06 | Yes | No. 61% |
| Case 6.14, s-RTT, BW=40MHz, X=160m | 0.39 | 0.56 | 0.75 | 1.07 | Yes | No. 61% |
| Case 6.17, s-RTT, BW=40MHz, X=160m | 0.40 | 0.58 | 0.77 | 1.11 | Yes | No. 60% |
|  |  |  |  |  |  |  |
| Case 6.3, s-RTT, BW=100MHz, X=80m | 0.31 | 0.43 | 0.53 | 0.64 | Yes | No. 76% |
| Case 6.6, s-RTT, BW=100MHz, X=80m | 0.32 | 0.44 | 0.54 | 0.68 | Yes | No. 74% |
| Case 6.9, s-RTT, BW=100MHz, X=80m | 0.32 | 0.43 | 0.54 | 0.65 | Yes | No. 75% |
| Case 6.12, s-RTT, BW=100MHz, X=160m | 0.33 | 0.45 | 0.55 | 0.69 | Yes | No. 73% |
| Case 6.15, s-RTT, BW=100MHz, X=160m | 0.33 | 0.45 | 0.56 | 0.69 | Yes | No. 73% |
| Case 6.18, s-RTT, BW=100MHz, X=160m | 0.33 | 0.45 | 0.56 | 0.71 | Yes | No. 73% |

**Table B.1.10.2.1-4 Simulation results for highway for ranging - distance accuracy (s-RTT, MUSIC + FB-ReTx)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID & brief description | 50% | 67% | 80% | 90% | Set A req. | Set B req. |
| Case 8.1, s-RTT, BW=20MHz, X=80m | 0.43 | 0.63 | 0.86 | 1.19 | Yes | No. 56% |
| Case 8.4, s-RTT, BW=20MHz, X=80m | 0.53 | 0.76 | 1.00 | 1.33 | Yes | No. 47% |
| Case 8.7, s-RTT, BW=20MHz, X=80m | 0.43 | 0.62 | 0.84 | 1.18 | Yes | No. 57% |
| Case 8.10, s-RTT, BW=20MHz, X=160m | 0.46 | 0.67 | 0.93 | 1.35 | Yes | No. 53% |
| Case 8.13, s-RTT, BW=20MHz, X=160m | 0.57 | 0.82 | 1.10 | 1.52 | No. 89% | No. 45% |
| Case 8.16, s-RTT, BW=20MHz, X=160m | 0.46 | 0.67 | 0.92 | 1.34 | Yes | No. 53% |
|  |  |  |  |  |  |  |
| Case 8.2, s-RTT, BW=40MHz, X=80m | 0.38 | 0.54 | 0.71 | 0.95 | Yes | No. 63% |
| Case 8.5, s-RTT, BW=40MHz, X=80m | 0.41 | 0.60 | 0.78 | 0.99 | Yes | No. 58% |
| Case 8.8, s-RTT, BW=40MHz, X=80m | 0.37 | 0.53 | 0.70 | 0.94 | Yes | No. 63% |
| Case 8.11, s-RTT, BW=40MHz, X=160m | 0.40 | 0.58 | 0.77 | 1.07 | Yes | No. 59% |
| Case 8.14, s-RTT, BW=40MHz, X=160m | 0.45 | 0.66 | 0.86 | 1.12 | Yes | No. 54% |
| Case 8.17, s-RTT, BW=40MHz, X=160m | 0.40 | 0.57 | 0.77 | 1.06 | Yes | No. 60% |
|  |  |  |  |  |  |  |
| Case 8.3, s-RTT, BW=100MHz, X=80m | 0.31 | 0.43 | 0.54 | 0.66 | Yes | No. 75% |
| Case 8.6, s-RTT, BW=100MHz, X=80m | 0.31 | 0.42 | 0.53 | 0.65 | Yes | No. 76% |
| Case 8.9, s-RTT, BW=100MHz, X=80m | 0.32 | 0.44 | 0.54 | 0.68 | Yes | No. 74% |
| Case 8.12, s-RTT, BW=100MHz, X=160m | 0.33 | 0.45 | 0.56 | 0.71 | Yes | No. 73% |
| Case 8.15, s-RTT, BW=100MHz, X=160m | 0.32 | 0.45 | 0.58 | 0.72 | Yes | No. 72% |
| Case 8.18, s-RTT, BW=100MHz, X=160m | 0.33 | 0.46 | 0.57 | 0.73 | Yes | No. 72% |

B.1.10.2.2 Positioning accuracy evaluation results for Sidelink absolute positioning (SL multi-RTT) for Highway Scenarios for V2X

Simulation results for ranging (SL multi-RTT) in highway scenarios for V2X use cases with matched filter-based estimation and without feedback-based retransmission are provided in Table B.1.10.2.2-1.

Simulation results for ranging (SL multi -RTT) in highway scenarios for V2X use cases with MUSCI-based estimation and without feedback-based retransmission are provided in Table B.1.10.2.2-2.

Simulation results for ranging (SL multi -RTT) in highway scenarios for V2X use cases with matched filter-based estimation and with feedback-based retransmission are provided in Table B.1.10.2.2-3.

Simulation results for ranging (SL multi -RTT) in highway scenarios for V2X use cases with MUSCI-based estimation and with feedback-based retransmission are provided in Table B.1.10.2.2-4.

**Table B.1.10.2.2-1 Simulation results for highway for absolute positioning - horizontal accuracy (m-RTT)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID & brief description | 50% | 67% | 80% | 90% | Set A req. | Set B req. |
| Case 10.1, m-RTT, BW=20MHz, RSU staggered | 0.74 | 1.03 | 1.41 | 2.21 | No. 82% | No. 30% |
| Case 10.7, m-RTT, BW=20MHz, RSU staggered | 0.73 | 1.08 | 1.76 | 8.36 | No. 77% | No. 32% |
| Case 10.13, m-RTT, BW=20MHz, RSU staggered | 0.92 | 1.81 | 14.64 | 27.03 | No. 64% | No. 27% |
| Case 10.19, m-RTT, BW=20MHz, RSU staggered | 0.74 | 1.02 | 1.41 | 2.16 | No. 82% | No. 30% |
| Case 10.25, m-RTT, BW=20MHz, RSU staggered | 0.72 | 1.04 | 1.58 | 3.23 | No. 79% | No. 32% |
| Case 10.31, m-RTT, BW=20MHz, RSU staggered | 0.84 | 1.43 | 3.76 | 17.12 | No. 68% | No. 28% |
| Case 10.37, m-RTT, BW=20MHz, RSU staggered | 0.75 | 1.04 | 1.43 | 2.17 | No. 82% | No. 29% |
| Case 10.43, m-RTT, BW=20MHz, RSU staggered | 0.72 | 1.03 | 1.53 | 2.86 | No. 80% | No. 32% |
| Case 10.49, m-RTT, BW=20MHz, RSU staggered | 0.83 | 1.33 | 2.72 | 9.81 | No. 70% | No. 28% |
| Case 10.4, m-RTT, BW=20MHz, RSU symmetric | 0.76 | 1.04 | 1.46 | 2.36 | No. 81% | No. 29% |
| Case 10.10, m-RTT, BW=20MHz, RSU symmetric | 0.73 | 1.10 | 1.84 | 7.86 | No. 76% | No. 32% |
| Case 10.16, m-RTT, BW=20MHz, RSU symmetric | 0.93 | 1.83 | 13.35 | 26.10 | No. 64% | No. 27% |
| Case 10.22, m-RTT, BW=20MHz, RSU symmetric | 0.76 | 1.04 | 1.44 | 2.23 | No. 81% | No. 29% |
| Case 10.28, m-RTT, BW=20MHz, RSU symmetric | 0.72 | 1.05 | 1.58 | 3.09 | No. 79% | No. 33% |
| Case 10.34, m-RTT, BW=20MHz, RSU symmetric | 0.84 | 1.38 | 3.13 | 15.62 | No. 69% | No. 29% |
| Case 10.40, m-RTT, BW=20MHz, RSU symmetric | 0.76 | 1.05 | 1.46 | 2.24 | No. 81% | No. 29% |
| Case 10.46, m-RTT, BW=20MHz, RSU symmetric | 0.73 | 1.07 | 1.60 | 2.96 | No. 78% | No. 32% |
| Case 10.52, m-RTT, BW=20MHz, RSU symmetric | 0.85 | 1.40 | 2.82 | 9.59 | No. 69% | No. 28% |
|  |  |  |  |  |  |  |
| Case 10.2, m-RTT, BW=40MHz, RSU staggered | 0.62 | 0.82 | 1.11 | 1.65 | No. 88% | No. 38% |
| Case 10.8, m-RTT, BW=40MHz, RSU staggered | 0.56 | 0.78 | 1.13 | 2.04 | No. 86% | No. 44% |
| Case 10.14, m-RTT, BW=40MHz, RSU staggered | 0.62 | 0.96 | 1.81 | 15.97 | No. 77% | No. 40% |
| Case 10.20, m-RTT, BW=40MHz, RSU staggered | 0.63 | 0.84 | 1.12 | 1.68 | No. 88% | No. 37% |
| Case 10.26, m-RTT, BW=40MHz, RSU staggered | 0.56 | 0.79 | 1.15 | 2.06 | No. 86% | No. 43% |
| Case 10.32, m-RTT, BW=40MHz, RSU staggered | 0.63 | 0.96 | 1.72 | 8.56 | No. 78% | No. 39% |
| Case 10.38, m-RTT, BW=40MHz, RSU staggered | 0.62 | 0.83 | 1.12 | 1.69 | No. 88% | No. 38% |
| Case 10.44, m-RTT, BW=40MHz, RSU staggered | 0.56 | 0.78 | 1.12 | 1.85 | No. 87% | No. 44% |
| Case 10.50, m-RTT, BW=40MHz, RSU staggered | 0.60 | 0.90 | 1.43 | 3.27 | No. 81% | No. 41% |
| Case 10.5, m-RTT, BW=40MHz, RSU symmetric | 0.63 | 0.85 | 1.14 | 1.73 | No. 88% | No. 37% |
| Case 10.11, m-RTT, BW=40MHz, RSU symmetric | 0.57 | 0.81 | 1.21 | 2.24 | No. 85% | No. 43% |
| Case 10.17, m-RTT, BW=40MHz, RSU symmetric | 0.64 | 1.02 | 2.01 | 16.39 | No. 76% | No. 39% |
| Case 10.23, m-RTT, BW=40MHz, RSU symmetric | 0.63 | 0.85 | 1.15 | 1.79 | No. 87% | No. 37% |
| Case 10.29, m-RTT, BW=40MHz, RSU symmetric | 0.57 | 0.80 | 1.18 | 2.10 | No. 85% | No. 43% |
| Case 10.35, m-RTT, BW=40MHz, RSU symmetric | 0.62 | 0.95 | 1.65 | 5.72 | No. 78% | No. 40% |
| Case 10.41, m-RTT, BW=40MHz, RSU symmetric | 0.63 | 0.85 | 1.15 | 1.76 | No. 87% | No. 37% |
| Case 10.47, m-RTT, BW=40MHz, RSU symmetric | 0.57 | 0.80 | 1.17 | 1.97 | No. 86% | No. 43% |
| Case 10.53, m-RTT, BW=40MHz, RSU symmetric | 0.62 | 0.94 | 1.51 | 3.38 | No. 80% | No. 40% |
|  |  |  |  |  |  |  |
| Case 10.3, m-RTT, BW=100MHz, RSU staggered | 0.47 | 0.61 | 0.77 | 1.07 | Yes | No. 54% |
| Case 10.9, m-RTT, BW=100MHz, RSU staggered | 0.40 | 0.52 | 0.69 | 1.09 | Yes | No. 64% |
| Case 10.15, m-RTT, BW=100MHz, RSU staggered | 0.40 | 0.56 | 0.81 | 1.50 | Yes | No. 62% |
| Case 10.21, m-RTT, BW=100MHz, RSU staggered | 0.48 | 0.62 | 0.77 | 1.06 | Yes | No. 53% |
| Case 10.27, m-RTT, BW=100MHz, RSU staggered | 0.40 | 0.53 | 0.69 | 1.07 | Yes | No. 64% |
| Case 10.33, m-RTT, BW=100MHz, RSU staggered | 0.40 | 0.55 | 0.78 | 1.34 | Yes | No. 62% |
| Case 10.39, m-RTT, BW=100MHz, RSU staggered | 0.49 | 0.64 | 0.81 | 1.13 | Yes | No. 51% |
| Case 10.45, m-RTT, BW=100MHz, RSU staggered | 0.42 | 0.56 | 0.74 | 1.14 | Yes | No. 60% |
| Case 10.51, m-RTT, BW=100MHz, RSU staggered | 0.42 | 0.58 | 0.83 | 1.37 | Yes | No. 59% |
| Case 10.6, m-RTT, BW=100MHz, RSU symmetric | 0.48 | 0.62 | 0.79 | 1.08 | Yes | No. 52% |
| Case 10.12, m-RTT, BW=100MHz, RSU symmetric | 0.40 | 0.54 | 0.73 | 1.16 | Yes | No. 63% |
| Case 10.18, m-RTT, BW=100MHz, RSU symmetric | 0.40 | 0.58 | 0.85 | 1.58 | No. 84% | No. 60% |
| Case 10.24, m-RTT, BW=100MHz, RSU symmetric | 0.48 | 0.63 | 0.79 | 1.09 | Yes | No. 52% |
| Case 10.30, m-RTT, BW=100MHz, RSU symmetric | 0.40 | 0.54 | 0.73 | 1.16 | Yes | No. 63% |
| Case 10.36, m-RTT, BW=100MHz, RSU symmetric | 0.40 | 0.57 | 0.83 | 1.46 | Yes | No. 61% |
| Case 10.42, m-RTT, BW=100MHz, RSU symmetric | 0.47 | 0.61 | 0.77 | 1.07 | Yes | No. 53% |
| Case 10.48, m-RTT, BW=100MHz, RSU symmetric | 0.40 | 0.53 | 0.72 | 1.13 | Yes | No. 64% |
| Case 10.54, m-RTT, BW=100MHz, RSU symmetric | 0.40 | 0.57 | 0.83 | 1.48 | Yes | No. 61% |
|  |  |  |  |  |  |  |
| Case 10.55, m-RTT, BW=400MHz, #anchor=3 | 0.22 | 0.27 | 0.33 | 0.39 | Yes | Yes |
| Case 10.56, m-RTT, BW=400MHz, #anchor=5 | 0.16 | 0.21 | 0.25 | 0.31 | Yes | Yes |
| Case 10.57, m-RTT, BW=400MHz, #anchor=7 | 0.14 | 0.18 | 0.22 | 0.28 | Yes | Yes |
| Case 10.58, m-RTT, BW=400MHz, #anchor=3 | 0.22 | 0.27 | 0.32 | 0.38 | Yes | Yes |
| Case 10.59, m-RTT, BW=400MHz, #anchor=5 | 0.16 | 0.21 | 0.26 | 0.30 | Yes | Yes |
| Case 10.60, m-RTT, BW=400MHz, #anchor=7 | 0.14 | 0.18 | 0.23 | 0.28 | Yes | Yes |
| Case 10.61, m-RTT, BW=400MHz, #anchor=3 | 0.21 | 0.27 | 0.32 | 0.38 | Yes | Yes |
| Case 10.62, m-RTT, BW=400MHz, #anchor=5 | 0.16 | 0.21 | 0.25 | 0.30 | Yes | Yes |
| Case 10.63, m-RTT, BW=400MHz, #anchor=7 | 0.14 | 0.18 | 0.22 | 0.28 | Yes | Yes |

**Table B.1.10.2.2-2 Simulation results for highway for absolute positioning - horizontal accuracy (m-RTT, MUSIC)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID & brief description | 50% | 67% | 80% | 90% | Set A req. | Set B req. |
| Case 12.1, m-RTT, BW=40MHz, #anchor=3 | 0.53 | 0.70 | 0.88 | 1.16 | Yes | No. 46% |
| Case 12.4, m-RTT, BW=40MHz, #anchor=5 | 0.43 | 0.58 | 0.75 | 1.02 | Yes | No. 58% |
| Case 12.7, m-RTT, BW=40MHz, #anchor=7 | 0.44 | 0.59 | 0.81 | 1.40 | Yes | No. 57% |
| Case 12.10, m-RTT, BW=40MHz, #anchor=3 | 0.52 | 0.68 | 0.86 | 1.12 | Yes | No. 47% |
| Case 12.13, m-RTT, BW=40MHz, #anchor=5 | 0.43 | 0.56 | 0.72 | 0.99 | Yes | No. 60% |
| Case 12.16, m-RTT, BW=40MHz, #anchor=7 | 0.42 | 0.58 | 0.78 | 1.30 | Yes | No. 58% |
| Case 12.19, m-RTT, BW=40MHz, #anchor=3 | 0.52 | 0.67 | 0.84 | 1.11 | Yes | No. 47% |
| Case 12.22, m-RTT, BW=40MHz, #anchor=5 | 0.43 | 0.55 | 0.71 | 0.94 | Yes | No. 60% |
| Case 12.25, m-RTT, BW=40MHz, #anchor=7 | 0.42 | 0.56 | 0.73 | 1.08 | Yes | No. 61% |
|  |  |  |  |  |  |  |
| Case 12.2, m-RTT, BW=100MHz, #anchor=3 | 0.44 | 0.56 | 0.68 | 0.85 | Yes | No. 58% |
| Case 12.5, m-RTT, BW=100MHz, #anchor=5 | 0.36 | 0.45 | 0.55 | 0.70 | Yes | No. 73% |
| Case 12.8, m-RTT, BW=100MHz, #anchor=7 | 0.34 | 0.44 | 0.56 | 0.73 | Yes | No. 74% |
| Case 12.11, m-RTT, BW=100MHz, #anchor=3 | 0.44 | 0.56 | 0.68 | 0.84 | Yes | No. 59% |
| Case 12.14, m-RTT, BW=100MHz, #anchor=5 | 0.36 | 0.45 | 0.54 | 0.69 | Yes | No. 75% |
| Case 12.17, m-RTT, BW=100MHz, #anchor=7 | 0.34 | 0.44 | 0.55 | 0.74 | Yes | No. 74% |
| Case 12.20, m-RTT, BW=100MHz, #anchor=3 | 0.43 | 0.55 | 0.67 | 0.82 | Yes | No. 60% |
| Case 12.23, m-RTT, BW=100MHz, #anchor=5 | 0.35 | 0.44 | 0.53 | 0.67 | Yes | No. 75% |
| Case 12.26, m-RTT, BW=100MHz, #anchor=7 | 0.33 | 0.42 | 0.53 | 0.69 | Yes | No. 76% |
|  |  |  |  |  |  |  |
| Case 12.3, m-RTT, BW=400MHz, #anchor=3 | 0.22 | 0.27 | 0.33 | 0.39 | Yes | Yes |
| Case 12.6, m-RTT, BW=400MHz, #anchor=5 | 0.16 | 0.21 | 0.25 | 0.31 | Yes | Yes |
| Case 12.9, m-RTT, BW=400MHz, #anchor=7 | 0.14 | 0.18 | 0.23 | 0.28 | Yes | Yes |
| Case 12.12, m-RTT, BW=400MHz, #anchor=3 | 0.22 | 0.27 | 0.32 | 0.38 | Yes | Yes |
| Case 12.15, m-RTT, BW=400MHz, #anchor=5 | 0.16 | 0.21 | 0.26 | 0.30 | Yes | Yes |
| Case 12.18, m-RTT, BW=400MHz, #anchor=7 | 0.14 | 0.18 | 0.23 | 0.28 | Yes | Yes |
| Case 12.21, m-RTT, BW=400MHz, #anchor=3 | 0.22 | 0.27 | 0.32 | 0.38 | Yes | Yes |
| Case 12.24, m-RTT, BW=400MHz, #anchor=5 | 0.16 | 0.21 | 0.25 | 0.30 | Yes | Yes |
| Case 12.27, m-RTT, BW=400MHz, #anchor=7 | 0.14 | 0.18 | 0.22 | 0.28 | Yes | Yes |

**Table B.1.10.2.2-3 Simulation results for highway for absolute positioning - horizontal accuracy (m-RTT, MF+FB-ReTx)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID & brief description | 50% | 67% | 80% | 90% | Set A req. | Set B req. |
| Case 14.1, m-RTT, BW=40MHz, #anchor=3 | 0.58 | 0.77 | 1.00 | 1.45 | Yes | No. 40% |
| Case 14.3, m-RTT, BW=40MHz, #anchor=5 | 0.50 | 0.68 | 0.91 | 1.37 | Yes | No. 49% |
| Case 14.7, m-RTT, BW=40MHz, #anchor=7 | 0.50 | 0.69 | 0.95 | 1.42 | Yes | No. 50% |
| Case 14.10, m-RTT, BW=40MHz, #anchor=3 | 0.57 | 0.75 | 0.98 | 1.38 | Yes | No. 42% |
| Case 14.13, m-RTT, BW=40MHz, #anchor=5 | 0.49 | 0.66 | 0.89 | 1.32 | Yes | No. 51% |
| Case 14.16, m-RTT, BW=40MHz, #anchor=7 | 0.49 | 0.67 | 0.91 | 1.33 | Yes | No. 51% |
| Case 14.19, m-RTT, BW=40MHz, #anchor=3 | 0.57 | 0.75 | 0.97 | 1.39 | Yes | No. 41% |
| Case 14.22, m-RTT, BW=40MHz, #anchor=5 | 0.49 | 0.67 | 0.87 | 1.28 | Yes | No. 50% |
| Case 14.25, m-RTT, BW=40MHz, #anchor=7 | 0.49 | 0.66 | 0.88 | 1.34 | Yes | No. 51% |
|  |  |  |  |  |  |  |
| Case 14.2, m-RTT, BW=100MHz, #anchor=3 | 0.47 | 0.60 | 0.74 | 0.98 | Yes | No. 54% |
| Case 14.5, m-RTT, BW=100MHz, #anchor=5 | 0.39 | 0.50 | 0.65 | 0.93 | Yes | No. 66% |
| Case 14.8, m-RTT, BW=100MHz, #anchor=7 | 0.37 | 0.50 | 0.67 | 0.98 | Yes | No. 67% |
| Case 14.11, m-RTT, BW=100MHz, #anchor=3 | 0.47 | 0.60 | 0.74 | 0.99 | Yes | No. 54% |
| Case 14.14, m-RTT, BW=100MHz, #anchor=5 | 0.39 | 0.50 | 0.64 | 0.92 | Yes | No. 66% |
| Case 14.17, m-RTT, BW=100MHz, #anchor=7 | 0.37 | 0.49 | 0.64 | 0.96 | Yes | No. 67% |
| Case 14.20, m-RTT, BW=100MHz, #anchor=3 | 0.47 | 0.60 | 0.74 | 0.99 | Yes | No. 53% |
| Case 14.23, m-RTT, BW=100MHz, #anchor=5 | 0.39 | 0.51 | 0.64 | 0.93 | Yes | No. 66% |
| Case 14.26, m-RTT, BW=100MHz, #anchor=7 | 0.37 | 0.50 | 0.66 | 0.98 | Yes | No. 67% |
|  |  |  |  |  |  |  |
| Case 14.3, m-RTT, BW=400MHz, #anchor=3 | 0.22 | 0.27 | 0.33 | 0.40 | Yes | Yes |
| Case 14.6, m-RTT, BW=400MHz, #anchor=5 | 0.16 | 0.21 | 0.26 | 0.31 | Yes | Yes |
| Case 14.9, m-RTT, BW=400MHz, #anchor=7 | 0.14 | 0.18 | 0.23 | 0.29 | Yes | Yes |
| Case 14.12, m-RTT, BW=400MHz, #anchor=3 | 0.22 | 0.27 | 0.32 | 0.38 | Yes | Yes |
| Case 14.15, m-RTT, BW=400MHz, #anchor=5 | 0.16 | 0.21 | 0.26 | 0.30 | Yes | Yes |
| Case 14.18, m-RTT, BW=400MHz, #anchor=7 | 0.14 | 0.18 | 0.22 | 0.28 | Yes | Yes |
| Case 14.21, m-RTT, BW=400MHz, #anchor=3 | 0.22 | 0.28 | 0.33 | 0.38 | Yes | Yes |
| Case 14.24, m-RTT, BW=400MHz, #anchor=5 | 0.17 | 0.22 | 0.26 | 0.30 | Yes | Yes |
| Case 14.27, m-RTT, BW=400MHz, #anchor=7 | 0.14 | 0.18 | 0.24 | 0.28 | Yes | Yes |

**Table B.1.10.2.2-4 Simulation results for highway for absolute positioning - horizontal accuracy (m-RTT, MUSIC+FB-ReTx)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID & brief description | 50% | 67% | 80% | 90% | Set A req. | Set B req. |
| Case 16.1, m-RTT, BW=40MHz, #anchor=3 | 0.52 | 0.68 | 0.84 | 1.07 | Yes | No. 47% |
| Case 16.3, m-RTT, BW=40MHz, #anchor=5 | 0.42 | 0.54 | 0.68 | 0.87 | Yes | No. 61% |
| Case 16.7, m-RTT, BW=40MHz, #anchor=7 | 0.39 | 0.52 | 0.67 | 0.88 | Yes | No. 64% |
| Case 16.10, m-RTT, BW=40MHz, #anchor=3 | 0.51 | 0.65 | 0.82 | 1.06 | Yes | No. 49% |
| Case 16.13, m-RTT, BW=40MHz, #anchor=5 | 0.41 | 0.53 | 0.66 | 0.86 | Yes | No. 63% |
| Case 16.16, m-RTT, BW=40MHz, #anchor=7 | 0.39 | 0.51 | 0.66 | 0.87 | Yes | No. 66% |
| Case 16.19, m-RTT, BW=40MHz, #anchor=3 | 0.50 | 0.65 | 0.81 | 1.04 | Yes | No. 50% |
| Case 16.22, m-RTT, BW=40MHz, #anchor=5 | 0.40 | 0.52 | 0.65 | 0.82 | Yes | No. 64% |
| Case 16.25, m-RTT, BW=40MHz, #anchor=7 | 0.38 | 0.50 | 0.65 | 0.83 | Yes | No. 66% |
|  |  |  |  |  |  |  |
| Case 16.2, m-RTT, BW=100MHz, #anchor=3 | 0.44 | 0.56 | 0.67 | 0.82 | Yes | No. 59% |
| Case 16.5, m-RTT, BW=100MHz, #anchor=5 | 0.34 | 0.43 | 0.53 | 0.65 | Yes | No. 76% |
| Case 16.8, m-RTT, BW=100MHz, #anchor=7 | 0.32 | 0.41 | 0.51 | 0.64 | Yes | No. 79% |
| Case 16.11, m-RTT, BW=100MHz, #anchor=3 | 0.43 | 0.55 | 0.67 | 0.83 | Yes | No. 60% |
| Case 16.14, m-RTT, BW=100MHz, #anchor=5 | 0.34 | 0.44 | 0.53 | 0.65 | Yes | No. 76% |
| Case 16.17, m-RTT, BW=100MHz, #anchor=7 | 0.32 | 0.41 | 0.51 | 0.64 | Yes | No. 78% |
| Case 16.20, m-RTT, BW=100MHz, #anchor=3 | 0.43 | 0.54 | 0.66 | 0.80 | Yes | No. 61% |
| Case 16.23, m-RTT, BW=100MHz, #anchor=5 | 0.34 | 0.43 | 0.52 | 0.64 | Yes | No. 78% |
| Case 16.26, m-RTT, BW=100MHz, #anchor=7 | 0.31 | 0.40 | 0.50 | 0.64 | Yes | No. 79% |
|  |  |  |  |  |  |  |
| Case 16.3, m-RTT, BW=400MHz, #anchor=3 | 0.22 | 0.28 | 0.33 | 0.40 | Yes | Yes |
| Case 16.6, m-RTT, BW=400MHz, #anchor=5 | 0.16 | 0.21 | 0.26 | 0.31 | Yes | Yes |
| Case 16.9, m-RTT, BW=400MHz, #anchor=7 | 0.14 | 0.18 | 0.23 | 0.29 | Yes | Yes |
| Case 16.12, m-RTT, BW=400MHz, #anchor=3 | 0.22 | 0.27 | 0.32 | 0.38 | Yes | Yes |
| Case 16.15, m-RTT, BW=400MHz, #anchor=5 | 0.16 | 0.21 | 0.26 | 0.30 | Yes | Yes |
| Case 16.18, m-RTT, BW=400MHz, #anchor=7 | 0.14 | 0.18 | 0.22 | 0.28 | Yes | Yes |
| Case 16.21, m-RTT, BW=400MHz, #anchor=3 | 0.22 | 0.28 | 0.33 | 0.37 | Yes | Yes |
| Case 16.24, m-RTT, BW=400MHz, #anchor=5 | 0.17 | 0.22 | 0.26 | 0.30 | Yes | Yes |
| Case 16.27, m-RTT, BW=400MHz, #anchor=7 | 0.14 | 0.18 | 0.24 | 0.28 | Yes | Yes |

B.1.10.2.3 Positioning accuracy evaluation results for Sidelink absolute positioning (SL TDOA) for Highway Scenarios for V2X

Simulation results for ranging (SL TDOA) in highway scenarios for V2X use cases with matched filter-based estimation and without feedback-based retransmission are provided in Table B.1.10.2.3-1.

Simulation results for ranging (SL TDOA) in highway scenarios for V2X use cases with MUSCI-based estimation and without feedback-based retransmission are provided in Table B.1.10.2.3-2.

Simulation results for ranging (SL TDOA) in highway scenarios for V2X use cases with matched filter-based estimation and with feedback-based retransmission are provided in Table B.1.10.2.3-3.

Simulation results for ranging (SL TDOA) in highway scenarios for V2X use cases with MUSCI-based estimation and with feedback-based retransmission are provided in Table B.1.10.2.3-4.

**Table B.1.10.2.3-1 Simulation results for highway for absolute positioning - horizontal accuracy (SL-TDOA)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID & brief description | 50% | 67% | 80% | 90% | Set A req. | Set B req. |
| Case 18.1, SL-TDOA, BW=20MHz, RSU staggered | 0.91 | 1.29 | 1.82 | 2.84 | No. 73% | No. 23% |
| Case 18.7, SL-TDOA, BW=20MHz, RSU staggered | 0.84 | 1.19 | 1.68 | 2.62 | No. 76% | No. 26% |
| Case 18.13, SL-TDOA, BW=20MHz, RSU staggered | 0.79 | 1.12 | 1.60 | 2.64 | No. 78% | No. 29% |
| Case 18.19, SL-TDOA, BW=20MHz, RSU staggered | 0.92 | 1.30 | 1.83 | 2.86 | No. 73% | No. 22% |
| Case 18.25, SL-TDOA, BW=20MHz, RSU staggered | 0.85 | 1.20 | 1.69 | 2.71 | No. 76% | No. 25% |
| Case 18.31, SL-TDOA, BW=20MHz, RSU staggered | 0.80 | 1.14 | 1.62 | 2.63 | No. 78% | No. 28% |
| Case 18.37, SL-TDOA, BW=20MHz, RSU staggered | 0.93 | 1.32 | 1.88 | 2.96 | No. 72% | No. 22% |
| Case 18.43, SL-TDOA, BW=20MHz, RSU staggered | 0.84 | 1.21 | 1.71 | 2.67 | No. 76% | No. 26% |
| Case 18.49, SL-TDOA, BW=20MHz, RSU staggered | 0.79 | 1.13 | 1.60 | 2.48 | No. 78% | No. 28% |
| Case 18.4, SL-TDOA, BW=20MHz, RSU symmetric | 0.95 | 1.36 | 1.95 | 3.14 | No. 71% | No. 22% |
| Case 18.10, SL-TDOA, BW=20MHz, RSU symmetric | 0.78 | 1.14 | 1.67 | 2.76 | No. 77% | No. 29% |
| Case 18.16, SL-TDOA, BW=20MHz, RSU symmetric | 0.73 | 1.04 | 1.47 | 2.33 | No. 81% | No. 31% |
| Case 18.22, SL-TDOA, BW=20MHz, RSU symmetric | 0.95 | 1.36 | 1.95 | 3.15 | No. 71% | No. 22% |
| Case 18.28, SL-TDOA, BW=20MHz, RSU symmetric | 0.79 | 1.13 | 1.64 | 2.65 | No. 77% | No. 29% |
| Case 18.34, SL-TDOA, BW=20MHz, RSU symmetric | 0.74 | 1.04 | 1.46 | 2.23 | No. 81% | No. 31% |
| Case 18.40, SL-TDOA, BW=20MHz, RSU symmetric | 0.95 | 1.37 | 1.98 | 3.20 | No. 71% | No. 21% |
| Case 18.46, SL-TDOA, BW=20MHz, RSU symmetric | 0.80 | 1.16 | 1.70 | 2.79 | No. 76% | No. 28% |
| Case 18.52, SL-TDOA, BW=20MHz, RSU symmetric | 0.76 | 1.08 | 1.54 | 2.41 | No. 79% | No. 29% |
|  |  |  |  |  |  |  |
| Case 18.2, SL-TDOA, BW=40MHz, RSU staggered | 0.76 | 1.06 | 1.47 | 2.26 | No. 81% | No. 29% |
| Case 18.8, SL-TDOA, BW=40MHz, RSU staggered | 0.67 | 0.93 | 1.29 | 1.99 | No. 84% | No. 34% |
| Case 18.14, SL-TDOA, BW=40MHz, RSU staggered | 0.63 | 0.88 | 1.22 | 1.97 | No. 85% | No. 38% |
| Case 18.20 SL-TDOA, BW=40MHz, RSU staggered | 0.76 | 1.06 | 1.49 | 2.29 | No. 80% | No. 29% |
| Case 18.26, SL-TDOA, BW=40MHz, RSU staggered | 0.68 | 0.95 | 1.31 | 2.08 | No. 84% | No. 34% |
| Case 18.32, SL-TDOA, BW=40MHz, RSU staggered | 0.63 | 0.88 | 1.23 | 1.92 | No. 85% | No. 38% |
| Case 18.38, SL-TDOA, BW=40MHz, RSU staggered | 0.76 | 1.05 | 1.47 | 2.30 | No. 81% | No. 29% |
| Case 18.44, SL-TDOA, BW=40MHz, RSU staggered | 0.69 | 0.95 | 1.31 | 2.06 | No. 84% | No. 33% |
| Case 18.50, SL-TDOA, BW=40MHz, RSU staggered | 0.63 | 0.88 | 1.23 | 1.92 | No. 85% | No. 38% |
| Case 18.5, SL-TDOA, BW=40MHz, RSU symmetric | 0.79 | 1.10 | 1.55 | 2.48 | No. 79% | No. 27% |
| Case 18.11, SL-TDOA, BW=40MHz, RSU symmetric | 0.64 | 0.91 | 1.30 | 2.17 | No. 84% | No. 37% |
| Case 18.17, SL-TDOA, BW=40MHz, RSU symmetric | 0.60 | 0.83 | 1.16 | 1.82 | No. 87% | No. 41% |
| Case 18.23, SL-TDOA, BW=40MHz, RSU symmetric | 0.79 | 1.11 | 1.58 | 2.58 | No. 79% | No. 28% |
| Case 18.29, SL-TDOA, BW=40MHz, RSU symmetric | 0.64 | 0.92 | 1.36 | 2.34 | No. 82% | No. 37% |
| Case 18.35, SL-TDOA, BW=40MHz, RSU symmetric | 0.60 | 0.85 | 1.22 | 1.98 | No. 85% | No. 40% |
| Case 18.41, SL-TDOA, BW=40MHz, RSU symmetric | 0.79 | 1.11 | 1.57 | 2.51 | No. 79% | No. 27% |
| Case 18.47, SL-TDOA, BW=40MHz, RSU symmetric | 0.65 | 0.93 | 1.35 | 2.24 | No. 83% | No. 37% |
| Case 18.53, SL-TDOA, BW=40MHz, RSU symmetric | 0.60 | 0.85 | 1.19 | 1.83 | No. 86% | No. 40% |
|  |  |  |  |  |  |  |
| Case 18.3, SL-TDOA, BW=100MHz, RSU staggered | 0.52 | 0.69 | 0.92 | 1.40 | Yes | No. 47% |
| Case 18.9, SL-TDOA, BW=100MHz, RSU staggered | 0.45 | 0.60 | 0.79 | 1.21 | Yes | No. 56% |
| Case 18.15, SL-TDOA, BW=100MHz, RSU staggered | 0.41 | 0.55 | 0.75 | 1.16 | Yes | No. 61% |
| Case 18.21, SL-TDOA, BW=100MHz, RSU staggered | 0.52 | 0.69 | 0.93 | 1.41 | Yes | No. 47% |
| Case 18.27, SL-TDOA, BW=100MHz, RSU staggered | 0.46 | 0.61 | 0.81 | 1.23 | Yes | No. 56% |
| Case 18.33, SL-TDOA, BW=100MHz, RSU staggered | 0.42 | 0.56 | 0.76 | 1.15 | Yes | No. 61% |
| Case 18.39, SL-TDOA, BW=100MHz, RSU staggered | 0.52 | 0.69 | 0.93 | 1.41 | Yes | No. 47% |
| Case 18.45, SL-TDOA, BW=100MHz, RSU staggered | 0.46 | 0.61 | 0.80 | 1.23 | Yes | No. 56% |
| Case 18.51, SL-TDOA, BW=100MHz, RSU staggered | 0.42 | 0.56 | 0.76 | 1.19 | Yes | No. 60% |
| Case 18.6, SL-TDOA, BW=100MHz, RSU symmetric | 0.54 | 0.72 | 0.97 | 1.46 | Yes | No. 45% |
| Case 18.12, SL-TDOA, BW=100MHz, RSU symmetric | 0.42 | 0.57 | 0.78 | 1.30 | Yes | No. 60% |
| Case 18.18, SL-TDOA, BW=100MHz, RSU symmetric | 0.39 | 0.53 | 0.72 | 1.09 | Yes | No. 64% |
| Case 18.24, SL-TDOA, BW=100MHz, RSU symmetric | 0.54 | 0.72 | 0.97 | 1.48 | Yes | No. 45% |
| Case 18.30, SL-TDOA, BW=100MHz, RSU symmetric | 0.42 | 0.57 | 0.79 | 1.33 | Yes | No. 60% |
| Case 18.36, SL-TDOA, BW=100MHz, RSU symmetric | 0.39 | 0.53 | 0.72 | 1.12 | Yes | No. 64% |
| Case 18.42, SL-TDOA, BW=100MHz, RSU symmetric | 0.54 | 0.73 | 0.99 | 1.50 | Yes | No. 45% |
| Case 18.48, SL-TDOA, BW=100MHz, RSU symmetric | 0.43 | 0.58 | 0.80 | 1.35 | Yes | No. 59% |
| Case 18.54, SL-TDOA, BW=100MHz, RSU symmetric | 0.39 | 0.54 | 0.73 | 1.15 | Yes | No. 63% |
|  |  |  |  |  |  |  |
| Case 18.55, SL-TDOA, BW=400MHz, #anchor=3 | 0.25 | 0.34 | 0.46 | 0.66 | Yes | No. 82% |
| Case 18.56, SL-TDOA, BW=400MHz, #anchor=5 | 0.19 | 0.25 | 1.35 | 0.44 | Yes | Yes |
| Case 18.57, SL-TDOA, BW=400MHz, #anchor=7 | 0.16 | 0.22 | 0.27 | 0.33 | Yes | Yes |
| Case 18.58, SL-TDOA, BW=400MHz, #anchor=3 | 0.25 | 0.35 | 0.47 | 0.66 | Yes | No. 82% |
| Case 18.59, SL-TDOA, BW=400MHz, #anchor=5 | 0.19 | 0.25 | 0.35 | 0.44 | Yes | Yes |
| Case 18.60, SL-TDOA, BW=400MHz, #anchor=7 | 0.16 | 0.22 | 0.27 | 0.33 | Yes | Yes |
| Case 18.61, SL-TDOA, BW=400MHz, #anchor=3 | 0.25 | 0.35 | 0.47 | 0.66 | Yes | No. 82% |
| Case 18.62, SL-TDOA, BW=400MHz, #anchor=5 | 0.20 | 0.26 | 0.35 | 0.43 | Yes | Yes |
| Case 18.63, SL-TDOA, BW=400MHz, #anchor=7 | 0.17 | 0.22 | 0.27 | 0.34 | Yes | Yes |

**Table B.1.10.2.3-2 Simulation results for highway for absolute positioning - horizontal accuracy (SL-TDOA, MUSIC)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID & brief description | 50% | 67% | 80% | 90% | Set A req. | Set B req. |
| Case 20.1, SL-TDOA, BW=40MHz, #anchor=3 | 0.60 | 0.80 | 1.06 | 1.47 | Yes | No. 39% |
| Case 20.4, SL-TDOA, BW=40MHz, #anchor=5 | 0.53 | 0.70 | 0.90 | 1.20 | Yes | No. 46% |
| Case 20.7, SL-TDOA, BW=40MHz, #anchor=7 | 0.47 | 0.63 | 0.83 | 1.12 | Yes | No. 53% |
| Case 20.10, SL-TDOA, BW=40MHz, #anchor=3 | 0.58 | 0.77 | 1.01 | 1.42 | Yes | No. 42% |
| Case 20.13, SL-TDOA, BW=40MHz, #anchor=5 | 0.52 | 0.69 | 0.90 | 1.24 | Yes | No. 48% |
| Case 20.16, SL-TDOA, BW=40MHz, #anchor=7 | 0.47 | 0.63 | 0.83 | 1.17 | Yes | No. 54% |
| Case 20.19, SL-TDOA, BW=40MHz, #anchor=3 | 0.58 | 0.78 | 1.02 | 1.40 | Yes | No. 41% |
| Case 20.22, SL-TDOA, BW=40MHz, #anchor=5 | 0.51 | 0.67 | 0.86 | 1.15 | Yes | No. 48% |
| Case 20.25, SL-TDOA, BW=40MHz, #anchor=7 | 0.46 | 0.61 | 0.79 | 1.05 | Yes | No. 54% |
|  |  |  |  |  |  |  |
| Case 20.2, SL-TDOA, BW=100MHz, #anchor=3 | 0.48 | 0.62 | 0.79 | 1.07 | Yes | No. 53% |
| Case 20.5, SL-TDOA, BW=100MHz, #anchor=5 | 0.41 | 0.53 | 0.65 | 0.82 | Yes | No. 63% |
| Case 20.8, SL-TDOA, BW=100MHz, #anchor=7 | 0.37 | 0.48 | 0.61 | 0.77 | Yes | No. 68% |
| Case 20.11, SL-TDOA, BW=100MHz, #anchor=3 | 0.47 | 0.62 | 0.78 | 1.06 | Yes | No. 53% |
| Case 20.14, SL-TDOA, BW=100MHz, #anchor=5 | 0.42 | 0.54 | 0.67 | 0.85 | Yes | No. 62% |
| Case 20.17, SL-TDOA, BW=100MHz, #anchor=7 | 0.37 | 0.49 | 0.61 | 0.76 | Yes | No. 68% |
| Case 20.20, SL-TDOA, BW=100MHz, #anchor=3 | 0.46 | 0.60 | 0.77 | 1.02 | Yes | No. 54% |
| Case 20.23, SL-TDOA, BW=100MHz, #anchor=5 | 0.40 | 0.52 | 0.64 | 0.80 | Yes | No. 64% |
| Case 20.26, SL-TDOA, BW=100MHz, #anchor=7 | 0.37 | 0.48 | 0.60 | 0.75 | Yes | No. 70% |
|  |  |  |  |  |  |  |
| Case 20.3, SL-TDOA, BW=400MHz, #anchor=3 | 0.26 | 0.35 | 0.47 | 0.68 | Yes | No. 82% |
| Case 20.6, SL-TDOA, BW=400MHz, #anchor=5 | 0.19 | 0.25 | 0.35 | 0.44 | Yes | Yes |
| Case 20.9, SL-TDOA, BW=400MHz, #anchor=7 | 0.17 | 0.22 | 0.27 | 0.33 | Yes | Yes |
| Case 20.12, SL-TDOA, BW=400MHz, #anchor=3 | 0.25 | 0.35 | 0.47 | 0.66 | Yes | No. 82% |
| Case 20.15, SL-TDOA, BW=400MHz, #anchor=5 | 0.19 | 0.25 | 0.35 | 0.44 | Yes | Yes |
| Case 20.18, SL-TDOA, BW=400MHz, #anchor=7 | 0.17 | 0.22 | 0.27 | 0.33 | Yes | Yes |
| Case 20.21, SL-TDOA, BW=400MHz, #anchor=3 | 0.25 | 0.35 | 0.47 | 0.66 | Yes | No. 82% |
| Case 20.24, SL-TDOA, BW=400MHz, #anchor=5 | 0.20 | 0.26 | 0.34 | 0.42 | Yes | Yes |
| Case 20.27, SL-TDOA, BW=400MHz, #anchor=7 | 0.17 | 0.22 | 0.27 | 0.35 | Yes | Yes |

**Table B.1.10.2.3-3 Simulation results for highway for absolute positioning - horizontal accuracy (SL-TDOA, MF+FB-ReTx)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID & brief description | 50% | 67% | 80% | 90% | Set A req. | Set B req. |
| Case 22.1, SL-TDOA, BW=40MHz, #anchor=3 | 0.70 | 0.95 | 1.32 | 1.94 | No. 84% | No. 32% |
| Case 22.4, SL-TDOA, BW=40MHz, #anchor=5 | 0.63 | 0.86 | 1.16 | 1.71 | No. 87% | No. 38% |
| Case 22.7, SL-TDOA, BW=40MHz, #anchor=7 | 0.57 | 0.78 | 1.05 | 1.55 | No. 89% | No. 43% |
| Case 22.10, SL-TDOA, BW=40MHz, #anchor=3 | 0.67 | 0.92 | 1.25 | 1.89 | No. 86% | No. 33% |
| Case 22.13, SL-TDOA, BW=40MHz, #anchor=5 | 0.63 | 0.86 | 1.16 | 1.68 | No. 87% | No. 37% |
| Case 22.16, SL-TDOA, BW=40MHz, #anchor=7 | 0.56 | 0.77 | 1.03 | 1.47 | Yes | No. 43% |
| Case 22.19, SL-TDOA, BW=40MHz, #anchor=3 | 0.68 | 0.94 | 1.27 | 1.88 | No. 85% | No. 33% |
| Case 22.22, SL-TDOA, BW=40MHz, #anchor=5 | 0.63 | 0.86 | 1.16 | 1.71 | No. 87% | No. 37% |
| Case 22.25, SL-TDOA, BW=40MHz, #anchor=7 | 0.57 | 0.79 | 1.05 | 1.48 | Yes | No. 43% |
|  |  |  |  |  |  |  |
| Case 22.2, SL-TDOA, BW=100MHz, #anchor=3 | 0.51 | 0.68 | 0.88 | 1.26 | Yes | No. 48% |
| Case 22.5, SL-TDOA, BW=100MHz, #anchor=5 | 0.45 | 0.60 | 0.77 | 1.09 | Yes | No. 55% |
| Case 22.8, SL-TDOA, BW=100MHz, #anchor=7 | 0.41 | 0.55 | 0.72 | 0.98 | Yes | No. 61% |
| Case 22.11, SL-TDOA, BW=100MHz, #anchor=3 | 0.51 | 0.68 | 0.88 | 1.27 | Yes | No. 48% |
| Case 22.14, SL-TDOA, BW=100MHz, #anchor=5 | 0.45 | 0.59 | 0.77 | 1.11 | Yes | No. 56% |
| Case 22.17, SL-TDOA, BW=100MHz, #anchor=7 | 0.41 | 0.55 | 0.72 | 1.04 | Yes | No. 62% |
| Case 22.20, SL-TDOA, BW=100MHz, #anchor=3 | 0.51 | 0.66 | 0.88 | 1.28 | Yes | No. 49% |
| Case 22.23, SL-TDOA, BW=100MHz, #anchor=5 | 0.45 | 0.58 | 0.76 | 1.09 | Yes | No. 57% |
| Case 22.26, SL-TDOA, BW=100MHz, #anchor=7 | 0.40 | 0.54 | 0.71 | 1.00 | Yes | No. 62% |
|  |  |  |  |  |  |  |
| Case 22.3, SL-TDOA, BW=400MHz, #anchor=3 | 0.25 | 0.34 | 0.46 | 0.66 | Yes | No. 82% |
| Case 22.6, SL-TDOA, BW=400MHz, #anchor=5 | 0.19 | 0.25 | 0.35 | 0.44 | Yes | Yes |
| Case 22.9, SL-TDOA, BW=400MHz, #anchor=7 | 0.16 | 0.22 | 0.27 | 0.33 | Yes | Yes |
| Case 22.12, SL-TDOA, BW=400MHz, #anchor=3 | 0.26 | 0.34 | 0.46 | 0.64 | Yes | No. 83% |
| Case 22.15, SL-TDOA, BW=400MHz, #anchor=5 | 0.19 | 0.25 | 0.33 | 0.41 | Yes | Yes |
| Case 22.18, SL-TDOA, BW=400MHz, #anchor=7 | 0.16 | 0.22 | 0.27 | 0.34 | Yes | Yes |
| Case 22.21, SL-TDOA, BW=400MHz, #anchor=3 | 0.26 | 0.34 | 0.46 | 0.64 | Yes | No. 83% |
| Case 22.24, SL-TDOA, BW=400MHz, #anchor=5 | 0.20 | 0.26 | 0.34 | 0.42 | Yes | Yes |

**Table B.1.10.2.3-4 Simulation results for highway for absolute positioning - horizontal accuracy (SL-TDOA, MUSIC+FB-ReTx)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID & brief description | 50% | 67% | 80% | 90% | Set A req. | Set B req. |
| Case 24.1, SL-TDOA, BW=40MHz, #anchor=3 | 0.59 | 0.78 | 1.02 | 1.39 | Yes | No. 40% |
| Case 24.4, SL-TDOA, BW=40MHz, #anchor=5 | 0.51 | 0.66 | 0.84 | 1.11 | Yes | No. 49% |
| Case 24.7, SL-TDOA, BW=40MHz, #anchor=7 | 0.45 | 0.60 | 0.76 | 0.99 | Yes | No. 56% |
| Case 24.10, SL-TDOA, BW=40MHz, #anchor=3 | 0.58 | 0.77 | 1.01 | 1.36 | Yes | No. 41% |
| Case 24.13, SL-TDOA, BW=40MHz, #anchor=5 | 0.51 | 0.66 | 0.84 | 1.10 | Yes | No. 49% |
| Case 24.16, SL-TDOA, BW=40MHz, #anchor=7 | 0.45 | 0.59 | 0.76 | 0.97 | Yes | No. 57% |
| Case 24.19, SL-TDOA, BW=40MHz, #anchor=3 | 0.59 | 0.78 | 1.00 | 1.37 | Yes | No. 40% |
| Case 24.22, SL-TDOA, BW=40MHz, #anchor=5 | 0.52 | 0.68 | 0.86 | 1.10 | Yes | No. 48% |
| Case 24.25, SL-TDOA, BW=40MHz, #anchor=7 | 0.45 | 0.60 | 0.75 | 0.97 | Yes | No. 55% |
|  |  |  |  |  |  |  |
| Case 24.2, SL-TDOA, BW=100MHz, #anchor=3 | 0.47 | 0.61 | 0.77 | 1.03 | Yes | No. 53% |
| Case 24.5, SL-TDOA, BW=100MHz, #anchor=5 | 0.41 | 0.52 | 0.63 | 0.78 | Yes | No. 64% |
| Case 24.8, SL-TDOA, BW=100MHz, #anchor=7 | 0.35 | 0.46 | 0.58 | 0.71 | Yes | No. 71% |
| Case 24.11, SL-TDOA, BW=100MHz, #anchor=3 | 0.47 | 0.61 | 0.77 | 1.03 | Yes | No. 53% |
| Case 24.14, SL-TDOA, BW=100MHz, #anchor=5 | 0.41 | 0.52 | 0.64 | 0.80 | Yes | No. 64% |
| Case 24.17, SL-TDOA, BW=100MHz, #anchor=7 | 0.36 | 0.47 | 0.58 | 0.73 | Yes | No. 70% |
| Case 24.20, SL-TDOA, BW=100MHz, #anchor=3 | 0.47 | 0.61 | 0.76 | 0.99 | Yes | No. 54% |
| Case 24.23, SL-TDOA, BW=100MHz, #anchor=5 | 0.40 | 0.52 | 0.63 | 0.78 | Yes | No. 64% |
| Case 24.26, SL-TDOA, BW=100MHz, #anchor=7 | 0.35 | 0.46 | 0.58 | 0.72 | Yes | No. 72% |
|  |  |  |  |  |  |  |
| Case 24.3, SL-TDOA, BW=400MHz, #anchor=3 | 0.26 | 0.34 | 0.46 | 0.64 | Yes | No. 83% |
| Case 24.6, SL-TDOA, BW=400MHz, #anchor=5 | 0.19 | 0.25 | 0.33 | 0.41 | Yes | Yes |
| Case 24.9, SL-TDOA, BW=400MHz, #anchor=7 | 0.17 | 0.21 | 0.27 | 0.34 | Yes | Yes |
| Case 24.12, SL-TDOA, BW=400MHz, #anchor=3 | 0.26 | 0.34 | 0.45 | 0.64 | Yes | No. 83% |
| Case 24.15, SL-TDOA, BW=400MHz, #anchor=5 | 0.19 | 0.25 | 0.32 | 0.41 | Yes | Yes |
| Case 24.18, SL-TDOA, BW=400MHz, #anchor=7 | 0.16 | 0.22 | 0.27 | 0.34 | Yes | Yes |
| Case 24.21, SL-TDOA, BW=400MHz, #anchor=3 | 0.26 | 0.34 | 0.45 | 0.64 | Yes | No. 83% |
| Case 24.24, SL-TDOA, BW=400MHz, #anchor=5 | 0.19 | 0.25 | 0.33 | 0.41 | Yes | Yes |
| Case 24.27, SL-TDOA, BW=400MHz, #anchor=7 | 0.17 | 0.22 | 0.27 | 0.34 | Yes | Yes |

B.1.11 Results from source [28]

B.1.11.1 Description of evaluation scenarios

**Table B.1.11.1-1: Sidelink positioning - evaluation assumptions for IIoT scenarios**

|  |  |
| --- | --- |
| **Parameter** | **Values** |
| Carrier frequency, GHz | 3.5GHz |
| Bandwidth, MHz | 1) 100 MHz  2) 20 MHz |
| Subcarrier spacing, kHz | 30kHz |
| Channel model | 1) InF-SH  2) InF-DH |
| Hall size | small hall (L=120m x W=60m): D=20m |
| Number of anchor UE and their locations | Shown in Table B.1.11.1-2 |
| Room height | 10 m |
| Number of floors | 1 |
| Clutter parameters: {density , height ,size } | 1) InF-SH - {20%, 2m, 10m}  2) InF-DH - {40%, 2m, 2m} |
| Synchronization error between anchor UEs | 0 ns |
| **Target UE model parameters** |  |
| UE noise figure, dB | 9dB |
| UE antenna configuration | Mg = 1, Ng = 1, P = 2, dH = 0.5λ, (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1) |
| UE antenna radiation pattern | Omni, 0dBi |
| UE horizontal drop procedure | Uniformly distributed covering entire factory floor |
| UE antenna height | 1.5 m |
| **Anchor UE model parameters** |  |
| Anchor UE TX power, dBm | 23dBm |
| Anchor UE antenna configuration | (M, N, P, Mg, Ng) = (1, 2, 2, 1, 1), dH=dV=0.5λ |
| Anchor UE antenna radiation pattern | Omni, 0dBi |
| Anchor UE antenna height | 8 m |

**Table B.1.11.1-2: Distributions of Anchor UEs for IIoT scenarios**

|  |  |
| --- | --- |
| Descriptions | Placement |
| 28 anchor UEs on equally spaced lattice with spacing D. | A picture containing chart  Description automatically generated |

B.1.11.2 Positioning accuracy evaluation results for Sidelink Positioning

B.1.11.2.1 Positioning accuracy evaluation results for Sidelink Positioning for IIoT

Table B.1.11.2.1-1 provides horizontal absolute positioning accuracy results using sidelink positioning for IIoT use cases with InF-SH and InF-DH scenario.

Table B.1.11.2.1-2 provides vertical absolute positioning accuracy results using sidelink positioning for IIoT use cases with InF-SH and InF-DH scenario.

**Table B.1.11.2.1-1: Horizontal accuracy of IIOT sidelink positioning (m)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Simulation Case** | **50% ile** | **67% ile** | **80% ile** | **90 %ile** | Whether meet the requirement of set A (If no, %-ile of UEs satisfying the target positioning accuracy requirement) | Whether meet the requirement of set B (If no, %-ile of UEs satisfying the target positioning accuracy requirement) |
| 1. SL-TDOA, InF-SH - {20%, 2m, 10m}, 100 MHz bandwidth | 0.7085 | 1.2506 | 1.8833 | 2.5966 | No | No |
| 2. SL-TDOA, InF-SH - {20%, 2m, 10m}, 100 MHz bandwidth, LOS TRP selection | 0.7202 | 1.0812 | 1.6074 | 2.2322 | No  (64%) | No  (14.5%) |
| 3. RTT, InF-SH - {20%, 2m, 10m}, 100 MHz bandwidth | 0.1907 | 0.2375 | 0.2920 | 0.3650 | Yes | No  (54%) |
| 4. SL-TDOA, InF-SH - {20%, 2m, 10m}, 20 MHz bandwidth | 1.3223 | 1.7906 | 2.3380 | 3.1479 | No  (42%) | No  (3%) |
| 5. SL-TDOA, InF-DH - {40%, 2m, 2m}, 100 MHz bandwidth | 1.2373 | 1.6755 | 2.2171 | 3.1033 | No  (40%) | No  (3.4%) |
| 6. SL-TDOA, InF-DH - {40%, 2m, 2m}, 20 MHz bandwidth | 1.5191 | 2.0438 | 2.5342 | 3.2165 | No | No |
| 7. RTT, InF-SH - {20% , 2m, 10m}, 20 MHz bandwidth | 0.4756 | 0.8031 | 1.0401 | 1.4879 | No  (78%) | No  (25%) |
| 8. RTT, InF-DH - {40% , 2m, 2m}, 100 MHz bandwidth | 0.4149 | 0.7406 | 1.2233 | 1.8605 | No  (75%) | No  (26%) |
| 9. RTT, InF-DH - {40% , 2m , 2m}, 20 MHz bandwidth | 0.6274 | 1.0487 | 1.6115 | 2.6384 | No | No |

**Table B.1.11.2.1-2: Vertical accuracy of IIOT sidelink positioning (m)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Simulation Case** | **50% ile** | **67% ile** | **80% ile** | **90 %ile** | Whether meet the requirement of set A (If no, %-ile of UEs satisfying the target positioning accuracy requirement) | Whether meet the requirement of set B (If no, %-ile of UEs satisfying the target positioning accuracy requirement) |
| 1. SL-TDOA, InF-SH - {20%, 2m, 10m}, 100 MHz bandwidth | 0.9877 | 1.4061 | 2.0108 | 3.3708 | No | No |
| 2. SL-TDOA, InF-SH - {20%, 2m, 10m}, 100 MHz bandwidth, LOS TRP selection | 1.1748 | 1.8494 | 2.7285 | 3.7424 | No  (44%) | No  (11%) |
| 3. RTT, InF-SH - {20%, 2m, 10m}, 100 MHz bandwidth | 0.6893 | 0.8201 | 0.9727 | 1.2306 | No  (82%) | No  (7.9%) |
| 4. SL-TDOA, InF-SH - {20%, 2m, 10m}, 20 MHz bandwidth | 1.4673 | 2.2443 | 3.2014 | 4.3288 | No  (34%) | No  (7%) |
| 5. SL-TDOA, InF-DH - {40%, 2m, 2m}, 100 MHz bandwidth | 1.4922 | 1.9271 | 3.1023 | 4.0550 | No  (23%) | No  (0.02%) |
| 6. SL-TDOA, InF-DH - {40%, 2m, 2m}, 20 MHz bandwidth | 1.4486 | 1.7740 | 2.7808 | 3.9196 | No | No |
| 7. RTT, InF-SH - {20% , 2m, 10m}, 20 MHz bandwidth | 1.8729 | 2.8905 | 3.7551 | 4.7461 | No  (42%) | No  (5%) |
| 8. RTT, InF-DH - {40% , 2m, 2m}, 100 MHz bandwidth | 2.4542 | 4.0226 | 5.7740 | 8.1041 | No  (30%) | No  (8%) |
| 9. RTT, InF-DH - {40% , 2m , 2m}, 20 MHz bandwidth | 3.4844 | 4.8590 | 6.4703 | 8.5470 | No | No |

B.1.12 Results from source [29]

B.1.12.1 Description of evaluation scenarios

Based on the agreement in RAN1#109e and RAN1#110 meeting, sidelink positioning is evaluated in V2X use case with highway scenario use case and commercial use case. In highway scenario, UE-type RSUs are uniformly located with 200m spacing on both sides of highway symmetrically and also anchor UEs are located in back and forth of the target UE with 10m spacing and in both sides of the target UE with 4m spacing. In this highway scenario, the target UE can receive SL positioning signal not only from UE-type RSU but also from the vicinity of anchor UEs. More details on evaluation assumptions are given in Tables B.1.12.1-1 through B.1.12.1-4.

**Table B.1.12.1-1 Common evaluation assumptions**

|  |  |
| --- | --- |
| **Parameter** |  |
| Carrier frequency | 6 GHz |
| Subcarrier spacing | 30 kHz |
| Reference Signal Transmission Bandwidth | 20/40/100 MHz |
| Positioning Reference Signal Information | NR DL PRS (Comb-2, 2-symbols, Gold sequence), 1 port |
| UE speed | 140 km/h |
| UE power | 23 dBm |
| Positioning methods (OTDOA, Multi-RTT, …) | RTT and TDOA based absolute positioning |
| Description of Measurement Algorithm (e.g. super resolution, interference cancellation, ….) | Threshold based peak detection (max Correlation) |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | Taylor series |
| Synchronization assumptions | The synchronization error, per UE dropping, is defined as a truncated Gaussian distribution of (T1 ns) rms values between anchor UEs and/or UE-type RSUs assuming a largest timing difference of T2 ns, where T2 = 2\*T1  - That is, the range of timing errors is [-T2, T2]  - T1:0ns (perfectly synchronized), 50ns (Optional) |
| Precoding assumptions (codebook, nrof antenna elements used, etc) | No precoding |

**B.1.12.1-2 Evaluation parameters for absolute positioning in V2X use case in highway scenario considering uncertainty of location coordinates**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | Case 1 | Case 2 | Case 3 |
| Uncertainty of location coordinates | No uncertainty in anchor UEs | Uncertainty in anchor UEs, selecting UE-type RSUs only | Uncertainty in anchor UEs, no anchor UE selection |

**B.1.12.1-3 Evaluation parameters for absolute positioning in V2X use case in highway scenario considering synchronization error**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | Case 4 | Case 5 | Case 6 |
| Synchronization assumptions | No synchronization error (T1:0ns) | synchronization errors (T1:50ns) only from anchor UEs | synchronization errors (T1:50ns) from UE-type RSU and anchor UEs |

**B.1.12.1-4 Evaluation parameters for absolute positioning in V2X use case in highway scenario considering different PRS transmission bandwidth**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | Case 7 | Case 8 | Case 9 |
| Reference Signal Transmission Bandwidth | 100MHz | 40MHz | 20MHz |

B.1.12.2 Positioning accuracy evaluation results for Sidelink Positioning

B.1.12.2.1 Positioning accuracy evaluation results for Sidelink Positioning for Highway Scenarios for V2X

Table B.1.12.2.1-1 provides horizontal absolute positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases.

**B.1.12.2.2.1-1: CDFs of horizontal positioning errors for absolute positioning in V2X use case in highway scenario**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case #1, BW#40M, FR#1, positioning method #RTT, No uncertainty in anchor UEs | 0.048m | 0.092m | 0.142m | 0.209m | Yes | Yes |
| Case #2, BW#40M, FR#1, positioning method #RTT, Uncertainty in anchor UEs, selecting UE-type RSUs only | 0.485m | 0.671m | 0.871m | 1.128m | Yes | No  If not, 54%-ile of UEs satisfying the target positioning accuracy requirement of 0.5m |
| Case #3, BW#40M, FR#1, positioning method #RTT, Uncertainty in anchor UEs, no anchor UE selection | 0.856m | 1.116m | 1.373m | 1.768m | No  If not, 84%-ile of UEs satisfying the target positioning accuracy requirement of 1.5m | No  If not, 22%-ile of UEs satisfying the target positioning accuracy requirement of 0.5m |
| Case #4, BW#40M, FR#1, positioning method #TDOA, No synchronization error | 0.443m | 0.731m | 1.057m | 1.454m | Yes | No  If not, 53%-ile of UEs satisfying the target positioning accuracy requirement of 0.5m |
| Case #5, BW#40M, FR#1, positioning method #TDOA, synchronization errors only from anchor UEs | 2.819m | 3.926m | 4.595m | 5.757m | No  If not, 23%-ile of UEs satisfying the target positioning accuracy requirement of 1.5m | No  If not, 7%-ile of UEs satisfying the target positioning accuracy requirement of 0.5m |
| Case #6, BW#40M, FR#1, positioning method #TDOA, synchronization errors from UE-type RSU and anchor UEs | 4.016m | 5.274m | 6.498m | 8.029m | No  If not, 14%-ile of UEs satisfying the target positioning accuracy requirement of 1.5m | No  If not, 5%-ile of UEs satisfying the target positioning accuracy requirement of 0.5m |
| Case #7, BW#100M, FR#1, positioning method #TDOA, No synchronization error | 0m | 0.005m | 0.052m | 0.147m | Yes | Yes |
| Case #8, BW#40M, FR#1, positioning method #TDOA, No synchronization error | 0.443m | 0.731m | 1.057m | 1.454m | Yes | No  If not, 53%-ile of UEs satisfying the target positioning accuracy requirement of 0.5m |
| Case #9, BW#20M, FR#1, positioning method #TDOA, No synchronization error | 1.298m | 1.779m | 2.292m | 2.891m | No  If not, 57%-ile of UEs satisfying the target positioning accuracy requirement of 1.5m | No  If not, 19%-ile of UEs satisfying the target positioning accuracy requirement of 0.5m |

B.1.13 Results from source [78]

B.1.13.1 Description of evaluation scenarios

Common assumptions applicable to all evaluated scenarios are provided in Table B.1.13.1-1.

**Table B.1.13.1-1 Common assumptions for sidelink positioning evaluations that are different from or not provided in Annex A.1 from [78]**

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| Carrier frequency | SL: 6GHz |
| Subcarrier spacing | 30KHz |
| Bandwidth | 100/40/20 MHz (default 100MHz) |
| UE or UE type RSU antenna configuration | Omni directional antennas, 1 polarisation (M, N, P, Mg, Ng) = (1, 1, 1, 1, 1) |
| Comb size | 2 |
| Number of symbols per SL-PRS | 2 |
| Interference modelling (ideal muting, or other) | Interference between positioning resources |
| Description of measurement algorithm (e.g. super resolution, interference cancellation…) | ToA based on the inflection point from the time correlation |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | Absolute positioning: TDOA Levenberg Marquardt.  LOS/NLOS ideal detector |
| Synchronization assumptions | Perfect synchronization |
| Precoding assumptions (codebook, etc) | No precoding |
| Power control | Constant TX power (no UE specific power control) |
| Timing advance (TA) setting | All RSUs are synchronized to a common reference. No UE specific TA setting |

Table B.1.13.1-2 provides the assumptions for evaluation three resource sharing scenarios (cases 2,3 and 4) and compared with the no sharing scenario in case 1.

**Table B.1.13.1-2: Interference modelling assumptions for absolute sidelink positioning evaluations that are different from or not provided in Annex A.1 from [78]**

|  |  |  |  |
| --- | --- | --- | --- |
| **Case ID** | **Resource sharing scheme** | **Power** | **Case Description** |
| Case1 | no sharing | 23dBm | Different resources are assigned to each SL-PRS in LOS channels |
| Case2 | CS multiplexing | 23dBm | Eight RSUs share the same REs. The RSU uses the same sequence, but different cyclic shift. The transmit power was 23dBm in LOS channels |
| Case 3 | code multiplex | 23dBm | Eight RSUs share the same REs. Different sequences (IDs) are assigned to each RSU in LOS channels |
| Case 4 | CS multiplexing | 0dBm | Compared to the configuration in case 2 the transmit power was reduced to 0 dBm in LOS channels |

Table B.1.13.1-3 provides the assumptions for cases5,6 and 7 for performance comparison for different bandwidth configurations under LOS and NLOS channels.

**Table B.1.13.1-3: Bandwidth for absolute sidelink positioning evaluations that are different from or not provided in Annex A.1 from [78]**

|  |  |  |
| --- | --- | --- |
| **Case ID** | **Bandwidth** | **Case Description** |
| Case 5 | 100MHz | Channel according to 37.885, no resource sharing and 23dBm Tx power. |
| Case 6 | 40MHz | Channel according to 37.885, no resource sharing and 23dBm Tx power. |
| Case 7 | 20MHz | Channel according to 37.885, no resource sharing and 23dBm Tx power. |

B.1.13.2 Positioning accuracy evaluation results for Sidelink Positioning

B.1.13.2.1 Positioning accuracy evaluation results for Sidelink Positioning for Highway Scenarios for V2X

Table B.1.13.2-1 provides horizontal absolute positioning accuracy results using SL-TDoA sidelink positioning for highway scenarios for V2X use cases.

**Table B.1.13.2-1: Horizontal absolute accuracy in meters for highway scenarios for V2X use cases from [78]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case | 50% | 67% | 80% | 90% | Whether meet the requirement of Set A | Whether meet the requirement of Set B |
| *Case 1- No Sharing*  *(Tx power = 23dBm)* | 0.15 | 0.20 | 0.28 | 0.35 | Yes | Yes |
| *Case 2- CS multiplexing*  *(Tx power = 23dBm)* | 0.15 | 0.21 | 0.28 | 0.35 | Yes | Yes |
| *Case 3- code multiplex*  *(Tx power = 23dBm)* | >2m | >2m | >2m | >2m | No | No |
| *Case 4- CS multiplexing*  *(Tx power = 0 dBm)* | 0.16 | 0.22 | 0.31 | 0.44 | Yes | Yes |
| *Case 5- SL-PRS BW 100MHz* | 0.17 | 0.24 | 0.33 | 0.47 | Yes | Yes |
| *Case 6- SL-PRS BW 40MHz* | 0.52 | 0.78 | 1.14 | 1.8 | No | No |
| *Case 7- SL-PRS BW 20MHz* | 1.19 | 1.73 | >2m | >2m | No | No |

B.1.14 Results from source [30]

B.1.14.1 Description of evaluation scenarios

Highway and urban V2X scenarios were evaluated for absolute positioning and ranging distance accuracy using sidelink positioning. The accuracy of absolute positioning and ranging distance and angle was evaluated in public safety and commercial scenarios using sidelink positioning and, in the commercial scenarios, using joint SL-Uu positioning as well. Finally, evaluation results for the accuracy of absolute positioning accuracy were provided for IIoT scenarios using both SL-only and joint SL-Uu positioning.

**Table B.1.14.1-1 Common assumptions for sidelink positioning evaluations**

|  |  |
| --- | --- |
| **Parameter** |  |
| **Reference Signal Physical Structure and Resource Allocation (RE pattern)** | Comb-4/4-symbols without interference across the devices |
| **Reference signal including PRS, SRS and SL-PRS** | QPSK sequence, 1 port |
| **Number of symbols used per occasion** | 4 |
| **number of occasions used per positioning estimate** | 1 |
| **Power-boosting level** | 0 dB |
| **Uplink power control (applied/not applied)** | Not applied |
| **interference modelling (ideal muting, or other)** | Ideal muting |
| **Description of Measurement Algorithm (e.g. super resolution, interference cancellation, ….)** | Threshold-based IFFT TOA Estimation |
| **Synchronization assumptions** | Ideal |
| **UE/gNB RX and TX timing error assumption** | Ideal |

**Table B.1.14.1-2 Additional assumptions for highway scenario in V2X use case**

|  |  |
| --- | --- |
| **Parameter** |  |
| Carrier frequency | 5.9 MHz |
| Subcarrier spacing | 30 kHz SCS |
| Reference Signal Transmission Bandwidth | 40, 100 MHz |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | Absolute positioning: multi-RTT with least square  Ranging: RTT |
| Precoding assumptions (codebook, nrof antenna elements used, etc) | 2x2 |
| RSU and base-station drop model | Parallel RSU, no base stations |
| X | 200m |

**Table B.1.14.1-3 Additional assumptions for urban scenario in V2X use case**

|  |  |
| --- | --- |
| **Parameter** |  |
| Carrier frequency | 5.9 MHz |
| Subcarrier spacing | 30 kHz SCS |
| Reference Signal Transmission Bandwidth | 40, 100 MHz |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | Absolute positioning: multi-RTT with least square  Ranging: RTT |
| Precoding assumptions (codebook, nrof antenna elements used, etc) | 2x2 |
| RSU and base-station drop model | RSU at every intersection, no base stations. |
| X | 30m |

**Table B.1.14.1-4 Additional assumptions for the public safety use case**

|  |  |
| --- | --- |
| **Parameter** |  |
| Carrier frequency | 700 MHz (FDD) |
| Subcarrier spacing | 15 kHz SCS |
| Reference Signal Transmission Bandwidth | 10, 20, 40 MHz |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | RANSAC with a cost function minimization |
| Precoding assumptions (codebook, nrof antenna elements used, etc) | Single Antenna used for transmission at a UE  UE (1,1,2)  TRP (2,2,2) |
| BS/RSU deployment | UMI 200m 19-site Hexagonal grid |
| Selected values of **X** (relative positioning or ranging is performed between two UEs within **X** m) | 20 outdoor UEs per sector uniformly dropped in the xy plane. Each device is trying to do ranging with the closest 10 devices. |
| Additional notes, if any | Channel model from TS 36.843 A.2.1.2 |

**Table B.1.14.1-5 Additional assumptions for the commercial use case**

|  |  |
| --- | --- |
| **Parameter** |  |
| Carrier frequency | 3.5 GHz (TDD) |
| Subcarrier spacing | 30 kHz SCS |
| Reference Signal Transmission Bandwidth | 100 MHz |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | Absolute positioning: multi-RTT and RTT+AoA, RANSAC with a cost function minimization.  Ranging distance and angle: RTT+AoA |
| Precoding assumptions (codebook, nrof antenna elements used, etc) | Single Antenna used for transmission at a UE  UE (1,2,2)  TRP (2,16,2) |
| Cellular Deployment layout Assumption and Channel model | UMI FR1, 200m ISD, 3.5 GHz, 30 KHz SCS, according to the simulation assumptions of TS 38.855 |
| D2D Channel model | Channel model from TS 36.843 A.2.1.2 |
| UE drop | 10 outdoor UEs per sector uniformly dropped in the xy plane. All UEs are outdoors, and no buildings are dropped. |
| Anchor UE selection for absolute positioning | Closest 10 devices are being simulated for ranging and Angle of Arrival (AoA) Estimation |
| SL PRS configuration | Comb-2/2-symbols without interference across the devices |
| Additional notes, if any | Channel model from TS 36.843 A.2.1.2 |

**Table B.1.14.1-6 Additional assumptions for the IIoT use case**

|  |  |
| --- | --- |
| **Parameter** |  |
| Carrier frequency | 3.5 GHz (TDD) |
| Subcarrier spacing | 30 kHz SCS |
| Reference Signal Transmission Bandwidth | 100 MHz |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | Absolute positioning: RTT+AoA, RANSAC with a cost function minimization. |
| Precoding assumptions (codebook, nrof antenna elements used, etc) | Single Antenna used for transmission at a UE  UE (1,2,2)  TRP (4,4,2) |
| Additional notes, if any | Channel model from TS 36.843 A.2.1.2 |

B.1.14.2 Positioning accuracy evaluation results for Sidelink Positioning

B.1.14.2.1 Positioning accuracy evaluation results for Sidelink Positioning for Highway Scenarios for V2X

**Table B.1.14.2.1-1: Sidelink positioning - horizontal absolute accuracy for highway scenario**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case #1, 100MHz, Multi-RTT | 1.1 | 1.9 | 2.3 | 3.1 | No (55th-%ile) | No (25th-%ile) |
| Case #2, 40MHz, Multi-RTT | 3.2 | 3.8 | 5.7 | 7.4 | No (14th-%ile) | No |

**Table B.1.14.2.1-2: Sidelink positioning - ranging accuracy for highway scenario**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case #3, 100MHz, RTT | 0.71 | 0.95 | 1.1 | 1.3 | Yes | No (36th-%ile) |
| Case #4, 40MHz, RTT | 1.8 | 2.5 | 3.0 | 3.6 | No (44th-%ile) | No (18th-%ile) |

B.1.14.2.2 Positioning accuracy evaluation results for Sidelink Positioning for Urban Scenarios for V2X

**Table B.1.14.2.2-1: Sidelink positioning - horizontal absolute accuracy for urban scenario**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case #1, 100MHz, Multi-RTT | 0.67 | 0.80 | 0.96 | 1.1 | Yes | No (29th-%ile) |
| Case #2, 40MHz, Multi-RTT | 2.8 | 3.3 | 3.7 | 4.1 | No (6th-%ile) | No |

**Table B.1.14.2.2-2: Sidelink positioning - ranging accuracy for urban scenario**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case #3, 100MHz, RTT | 0.75 | 1.1 | 1.3 | 1.4 | Yes | No (36th-%ile) |
| Case #4, 40MHz, RTT | 2.4 | 3.2 | 3.8 | 4.7 | No (31st-%ile) | No (11th-%ile) |

B.1.14.2.3 Positioning accuracy evaluation results for Sidelink Positioning for Public Safety

**Table B.1.14.2.3-1: Sidelink positioning - horizontal absolute accuracy for public safety**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement |
| Case 1, 10 MHz, RTT+AoA | 2 m | 2.6 m | 3.1 m | 4.6 m | No (20% meets < 1m) |
| Case 2, 20 MHz, RTT+AoA | 1.6 m | 2 m | 2.3 m | 2.8 m | No (25% meets < 1m) |
| Case 3, 40 MHz, RTT+AoA | 0.3 m | 0.4 m | 0.7m | 1.1m | No (87.5% meets < 1m) |
| Case 1, 10 MHz, RTT | 2.4 m | 3 m | 4.1 m | 5.8 m | No (12% meets < 1m) |
| Case 2, 20 MHz, RTT | 1.9 m | 2.5 m | 2.8 m | 3.7 m | No (15% meets < 1m) |
| Case 3, 40 MHz, RTT | 0.4 m | 0.5 m | 0.9 m | 1.8m | No (80% meets < 1m) |

**Table B.1.14.2.3-2: Simulation results for public safety for ranging - distance accuracy**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement |
| Case 1, 10 MHz, RTT | 3.3 m | 4.6 m | 8.1 | >50 m | No (5% meets <1m) |
| Case 2, 20 MHz, RTT | 1.4 m | 2.1 m | 3.3 m | 9.5 m | No (15% meets <1m) |
| Case 3, 40 MHz, RTT | 0.7 m | 1.1 m | 4.7 m | 13.5 m | No (25% meets <1m) |

**Table B.1.14.2.3-3: Simulation results for public safety for ranging - angle accuracy**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement |
| Case 4, 10 MHz, AoA | 4.7 deg | 8.0 deg | 11.6 deg | 16.1 deg | Set A: No (86.5% meets < 15 deg)  Set B: No (67.5% meets < 8 deg) |
| Case 5, 20 MHz, AoA | 2.7 deg | 5.1 deg | 7.3 deg | 11.0 deg | Set A: Yes  Set B: No (83% meets < 8 deg) |
| Case 6, 40 MHz, AoA | 2.7 deg | 4.4 deg | 6.4 deg | 10.5 deg | Set A: Yes  Set B: No (86% meets < 8 deg) |

B.1.14.2.4 Positioning accuracy evaluation results for Sidelink Positioning for the Commercial Use Case

**Table B.1.14.2.4-1: Sidelink positioning - horizontal absolute accuracy for the commercial use cases**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement |
| Case 1, 100 MHz, FR1, SL/Uu-Positioning, 3 SL Anchors, Uu RTT+AoA & SL RTT+AoA | 0.3 m | 0.4 m | 0.5 m | 0.6 m | Yes |
| Case 2, 100 MHz, FR1, SL-Only, 3 SL Anchors, SL RTT+AoA | 0.3 m | 0.4 m | 0.5 m | 0.7 m | Yes |
| Case 3, 100 MHz, FR1, SL-Only, 3 SL Anchors, SL RTT | 0.35 m | 0.38 m | 0.75 m | 1.8 m | No (85% meets <1m) |

B.1.14.2.5 Positioning accuracy evaluation results for Sidelink Positioning for IIoT

**Table B.1.14.2.5-1: Sidelink positioning - horizontal absolute accuracy for IIoT**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case ID and brief description | 50% | 67% | 80% | 90% | Whether meet the requirement of set A | Whether meet the requirement of set B |
| Case 1, 100 MHz, InF-SH, 3 SL Anchors, Uu RTT+AoA and SL RTT+AoA | 0.1 m | 0.18 m | 0.25 m | 0.45 m | Yes | No (70% meet <0.2m) |
| Case 2, 100 MHz, InF-SH, 5 SL Anchors, Uu RTT+AoA and SL RTT+AoA | 0.1 m | 0.18 m | 0.3 m | 0.7 m | Yes | No (70% meet <0.2m) |

B.1.15 Results from source [31]

B.1.15.1 Description of evaluation scenarios

Common assumptions applicable to all evaluated scenarios are provided in Table B.1.15.1-1. Additional assumptions for each use case are provided in Table B.1.15.1-2, Table B.1.15.1-3, Table B.1.15.1-4 and Table B.1.15.1-5.

**Table B.1.15.1-1: Common assumptions for sidelink positioning evaluations [31]**

|  |  |
| --- | --- |
| **Parameter** |  |
| Scenario (baseline, otherwise state any modifications) | Baseline |
| Carrier frequency | 6GHz |
| Subcarrier spacing | 30KHz |
| Reference Signal Transmission Bandwidth | 100 MHz |
| Reference Signal Physical Structure and Resource Allocation (RE pattern) (reference to figure in contribution) | DL PRS: Comb-2 |
| Reference signal  (type of sequence, number of ports, …) | DL PRS: single port |
| Number of sites | 1 |
| Number of symbols used per occasion | DL PRS: 2 symbols |
| number of occasions used per positioning estimate | 1 |
| Power-boosting level | DL PRS: 3 dB |
| Uplink power control (applied/not applied) | N/A |
| interference modelling (ideal muting, or other) | Ideal muting |
| Description of Measurement Algorithm (e.g. super resolution, interference cancellation, ….) | MUSIC |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | Taylor series |
| Network synchronization assumptions | Ideal synchronization |
| UE/gNB RX and TX timing error | No timing calibration error |
| Beam-related assumption (beam sweeping / alignment assumptions at the tx and rx sides) | No Tx/Rx beam sweeping |
| Precoding assumptions (codebook, nrof antenna elements used, etc) | Single Tx port |
| UE antenna configuration | (1, 2, 2, 1, 1) |
| Number of UE branches | 4 |
| Description of enhancement solutions, if any | N/A |
| gNB antenna configuration | N/A |
| UE noise figure | 9 dB |
| UE antenna height | VUE: 1.6m, RSU: 5m |
| gNB antenna height | N/A |

**Table B.1.15.1-2: Additional assumptions for V2X highway scenario**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameters** | Case 1 | Case 2 | Case 3 | Case 4 |
| X | 50 | 100 | 50 | 100 |
| Bandwidth | 40MHz | 40MHz | 100MHz | 100MHz |
| Positioning method | RTT | RTT | RTT | RTT |
| **Parameters** | Case 5 | Case 6 | Case 7 | Case 8 |
| RSU deployment | Symmetric | Staggered | Symmetric | Staggered |
| Bandwidth | 40MHz | 40MHz | 100MHz | 100MHz |
| Positioning method | TDOA | TDOA | TDOA | TDOA |

**Table B.1.15.1-3: Additional assumptions for V2X urban grid scenario**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 9 | Case 10 | Case 11 | Case 12 | Case 13 | Case 14 |
| X | 50 | 100 | 50 | 100 | N/A | N/A |
| Bandwidth | 40MHz | 40MHz | 100MHz | 100MHz | 40MHz | 100MHz |
| Positioning method | RTT | RTT | RTT | RTT | TDOA | TDOA |

**Table B.1.15.1-4: Additional assumptions for IIoT use case**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 15 | Case 16 | Case 17 | Case 18 | Case 19 | Case 20 |
| X | 10 | 50 | 10 | 50 | N/A | N/A |
| Bandwidth | 100MHz | 100MHz | 100MHz | 100MHz | 100MHz | 100MHz |
| Link type | LoS only | LoS only | All | All | All | LoS only |
| Positioning method | RTT | RTT | RTT | RTT | TDOA | TDOA |

**Table B.1.15.1-5: Additional assumptions for commercial use case**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 21 | Case 16 | Case 17 | Case 18 | Case 19 | Case 20 |
| X | 10 | 50 | 10 | 50 | N/A | N/A |
| Bandwidth | 100MHz | 100MHz | 100MHz | 100MHz | 100MHz | 100MHz |
| Link type | LoS only | LoS only | All | All | All | LoS only |
| Positioning method | RTT | RTT | RTT | RTT | TDOA | TDOA |

B.1.15.2 Positioning accuracy evaluation results for Sidelink Positioning

B.1.15.2.1 Positioning accuracy evaluation results for Sidelink Positioning for Highway Scenarios for V2X

Table B.1.15.2.1-1 provides ranging distance accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.15.2.1-2 provides horizontal absolute positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases.

**Table B.1.15.2.1-1: Sidelink positioning - ranging distance accuracy for highway scenarios for V2X use cases from [31]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of Set A** | **Whether meet the requirement of Set B** |
| Case 1, No RSU  BW=40MHz, X=50m | 0.5674 | 0.8595 | 1.2340 | 1.6772 | No  (85.3%) | No  (45.9%) |
| Case 2, No RSU  BW=40MHz, X=100m | 0.5627 | 0.8754 | 1.2657 | 1.7267 | No  (84.3%) | No  (45.1%) |
| Case 3, No RSU  BW=100MHz, X=50m | 0.3268 | 0.5167 | 0.6955 | 0.9988 | Yes | No  (66.8%) |
| Case 4, No RSU  BW=100MHz, X=100m | 0.3246 | 0.5073 | 0.7125 | 1.0147 | Yes | No  (67.5%) |

**Table B.1.15.2.1-2: Sidelink positioning - - horizontal absolute accuracy for highway scenarios for V2X use cases from [31]**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Case** | | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of Set A** | **Whether meet the requirement of Set B** |
| Case 5, RSU (symmetric)  BW=40MHz | Horizontal | 1.7843 | 2.5839 | 3.7326 | 5.0870 | No  (42.2%) | No  (9.2%) |
| Direction along the road (X) | 0.3208 | 0.4736 | 0.6003 | 0.8393 |  |  |
| Direction perp. to the road (Y) | 1.7593 | 2.5483 | 3.6461 | 5.0858 |  |  |
| Case 6, RSU (staggered)  BW=40MHz | Horizontal | 1.7848 | 2.5153 | 3.6933 | 4.9242 | No  (43.0%) | No  (9.2%) |
| Direction along the road (X) | 0.3245 | 0.4751 | 0.6018 | 0.8219 |  |  |
| Direction perp. to the road (Y) | 1.7629 | 2.5035 | 3.5550 | 4.9230 |  |  |
| Case 7, RSU  (symmetric)  BW=100MHz | Horizontal | 0.8877 | 1.3001 | 1.7296 | 2.3902 | No  (71.3%) | No  (30.4%) |
| Direction along the road (X) | 0.1632 | 0.2310 | 0.3062 | 0.4348 |  |  |
| Direction perp. to the road (Y) | 0.8575 | 1.2905 | 1.7110 | 2.3579 |  |  |
| Case 8, RSU (Staggered)  BW=100MHz | Horizontal | 0.8877 | 1.2954 | 1.6748 | 2.2716 | No  (72.2%) | No  (31.3%) |
| Direction along the road (X) | 0.1633 | 0.2281 | 0.3053 | 0.4348 |  |  |
| Direction perp. to the road (Y) | 0.8575 | 1.2847 | 1.6426 | 2.2670 |  |  |

B.1.15.2.2 Positioning accuracy evaluation results for Sidelink Positioning for Urban Grid Scenarios for V2X

Table B.1.15.2.2-1 provides ranging distance accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

Table B.1.15.2.2-2 provides horizontal absolute positioning accuracy results using sidelink positioning for urban grid scenarios for V2X use cases.

**Table B.1.15.2.2-1: Sidelink positioning - ranging distance accuracy for urban grid scenarios for V2X use cases from [31]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case | 50% | 67% | 80% | 90% | Whether meet the requirement of Set A | Whether meet the requirement of Set B |
| Case 9, No RSU  BW=40MHz, X=50m | 0.8530 | 1.3433 | 1.9306 | 3.5304 | No  (72.4%) | No  (34.2%) |
| Case 10, No RSU  BW=40MHz, X=100m | 0.9537 | 1.5218 | 2.3618 | 4.1848 | No  (66.1%) | No  (30.4%) |
| Case 11, No RSU  BW=100MHz, X=50m | 0.4730 | 0.7526 | 1.1483 | 2.0263 | No  (83.8%) | No  (52.5%) |
| Case 12, No RSU  BW=100MHz, X=100m | 0.5205 | 0.8853 | 1.5914 | 3.0596 | No  (78.6%) | No  (49.0%) |

**Table B.1.15.2.2-2: Sidelink positioning - horizontal absolute accuracy for urban grid scenarios for V2X use cases from [31]**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Case | | 50% | 67% | 80% | 90% | Whether meet the requirement of Set A | Whether meet the requirement of Set B |
| Case 13, RSU  BW=40MHz | Horizontal | 2.8165 | 4.0782 | 5.9472 | 8.9635 | No  (22.2%) | No  (2.7%) |
| Case 14, RSU  BW=100MHz | Horizontal | 2.0612 | 3.5916 | 5.1706 | 7.9541 | No  (37.2%) | No  (10.2%) |

B.1.15.2.3 Positioning accuracy evaluation results for Sidelink Positioning for IIoT

Table B.1.15.2.3-1 provides ranging distance accuracy results using sidelink positioning for IIoT use cases with InF-SH scenario.

Table B.1.15.2.3-2 provides horizontal absolute positioning accuracy results using sidelink positioning for IIoT use cases with InF-SH scenario.

**Table B.1.15.2.3-1: Sidelink positioning - ranging distance accuracy of InF-SH scenarios for IIoT use cases from [31]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case | 50% | 67% | 80% | 90% | Whether meet the requirement of Set A | Whether meet the requirement of Set B |
| Case 15, LoS only,  BW=100MHz, X=10m | 0.4692 | 0.8107 | 1.0040 | 1.1001 | No  (80.00%) | No  (32.00%) |
| Case 16, LoS only,  BW=100MHz, X=50m | 0.4981 | 0.7859 | 1.1324 | 2.1350 | No  (75.39%) | No  (27.49%) |
| Case 17,  BW=100MHz, X=10m | 0.5122 | 0.8246 | 1.0537 | 1.1929 | No  (75.76%) | No  (18.18%) |
| Case 18,  BW=100MHz, X=50m | 0.4943 | 0.7885 | 1.1493 | 2.1981 | No  (75.57%) | No  (25.38%) |

**Table B.1.15.2.3-2: Sidelink positioning - horizontal absolute accuracy of InF-SH scenarios for IIoT use cases from [31]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case | 50% | 67% | 80% | 90% | Whether meet the requirement of Set A | Whether meet the requirement of Set B |
| Case 19,  BW=100MHz | 0.4510 | 0.6308 | 1.0429 | 1.3978 | No  (78%) | No  (10%) |
| Case 20, LoS only,  BW=100MHz | 0.5366 | 0.6776 | 0.8270 | 1.1168 | No  (85%) | No  (10%) |

B.1.15.2.4 Positioning accuracy evaluation results for Sidelink Positioning for Commercial

Table B.1.15.2.4-1 provides ranging distance accuracy results using sidelink positioning for commercial use cases

**Table B.1.15.2.4-1: Sidelink positioning – ranging distance accuracy of commercial use cases from [31]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case | 50% | 67% | 80% | 90% | Whether meet the requirement of Set A | Whether meet the requirement of Set B |
| Case 21,  BW=100MHz, X=10m | 0.2748 | 0.5256 | 0.6547 | 0.9719 | Yes | No  (41.54%) |
| Case 22,  BW=100MHz, X=25m | 0.3454 | 0.5457 | 0.7935 | 1.0131 | No  (89.90%) | No  (33.52%) |
| Case 23,  BW=100MHz, X=50m | 0.3807 | 0.5754 | 0.8269 | 1.0579 | No  (87.94%) | No  (30.47%) |
| Case 24,  BW=40MHz, X=10m | 0.6802 | 1.0826 | 1.4338 | 1.6441 | No  (63.08%) | No  (24.62%) |
| Case 25,  BW=40MHz, X=25m | 0.7525 | 1.2835 | 1.6259 | 2.0805 | No  (58.67%) | No  (22.22%) |
| Case 26,  BW=40MHz, X=50m | 0.8298 | 1.3033 | 1.7401 | 2.2347 | No  (56.64%) | No  (18.01%) |

B.1.16 Results from source [32]

B.1.16.1 Description of evaluation scenarios

Highway and urban grid scenarios are evaluated for V2X use case for absolute and relative horizontal accuracy. Further, distance ranging is evaluated for the same cases. Evaluation is performed using Uu link and SL links (from RSU and anchor V2X UEs) and results from best link combinations are provided here. Common assumptions applicable to all evaluated scenarios are provided in Table B.1.16.1-1.

**Table B.1.16.1-1 Common assumptions for sidelink positioning evaluations that are different from or not provided in Annex A.1 from [32]**

|  |  |
| --- | --- |
| **Parameter** | **Values** |
| Carrier frequency | FR1, FR2 |
| Subcarrier spacing | FR1: 15KHz,30KHz FR2:60KHz,120KHz |
| Reference Signal Transmission Bandwidth | FR1: 20MHz, 40MHz, 100MHz  FR2: 200MHz, 400MHz |
| Reference Signal Physical Structure and Resource Allocation (RE pattern) | (6,6) staggered pattern |
| Reference signal including PRS, SRS and SL-PRS  (type of sequence, number of ports, …) | NR PRS |
| Number of symbols used per occasion | 8 |
| number of occasions used per positioning estimate | 1 |
| interference modelling (ideal muting, or other) | Ideal muting |
| Description of Measurement Algorithm (e.g. super resolution, interference cancellation, ….) | TDOA using ESPRIT (Super resolution) |
| Description of positioning technique / applied positioning algorithm (e.g., Least square, Taylor series, etc) | Least square |
| Synchronization assumptions | Perfectly synchronization |
| UE/gNB RX and TX timing error assumption | Perfectly Synchronized |
| Precoding assumptions (codebook, nr of antenna elements used, etc) | Not considered |

Evaluation cases and relevant additional assumptions for highway scenarios for V2X use cases are provided in Table B.1.16.1-2.

**Table B.1.16.1-2 Assumptions for sidelink positioning in highway scenarios for V2X use cases that are different from or not provided in Annex A.1 from [32]**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameters** | **Case 1, Case 5, Case 8 BW-100MHz, FR1, TDOA** | **Case 2, Case 6, case 9 BW-40MHz, FR1, TDOA** | **Case 3, Case 7, case 10, BW-20MHz, FR1, TDOA** | **Case 4, Case 11, BW-200MHz, FR2,TDOA** |
| UE Antenna model | (M, N, P, Mg, Ng) = (2, 1, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (2, 1, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (2, 1, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (2, 1, 1, 1, 1), dH=dV=0.5λ |
| TRP antenna model | (M, N, P, Mg, Ng) = (4, 16, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (4, 16, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (4, 16, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (4, 16, 1, 1, 1), dH=dV=0.5λ |
| BS/RSU deployment for absolute positioning | as per 37.885 | as per 37.885 | as per 37.885 | as per 37.885 |
| BS/RSU deployment for relative positioning/ranging | as per 37.885 | as per 37.885 | as per 37.885 | as per 37.885 |
| Selected values of **X** (relative positioning or ranging is performed between two UEs within **X** m) | 25m to 200m | 25m to 200m | 25m to 200m | 25m to 200m |
| Assisting UEs | 10 | 10 | 10 | 10 |
| Positioning method | TDOA | TDOA | TDOA | TDOA |

Evaluation cases and relevant additional assumptions for urban grid scenario for V2X use cases are provided in Table B.1.16.1-3.

**Table B.1.16.1-3 Assumptions for sidelink positioning in urban grid scenario for V2X use cases that are different from or not provided in Annex A.1 from [32]**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameters** | **Case 12, Case 16, Case 19, BW-100MHz, FR1, TDOA** | **Case 13, Case 17, Case 20, BW-40MHz, FR1, TDOA** | **Case 14, Case 18, Case 21, BW-20MHz, FR1, TDOA** | **Case 15, Case 22, BW-200MHz, FR2, TDOA** |
| UE Antenna model | (M, N, P, Mg, Ng) = (2, 1, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (2, 1, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (2, 1, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (2, 1, 1, 1, 1), dH=dV=0.5λ |
| TRP antenna model | (M, N, P, Mg, Ng) = (4, 16, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (4, 16, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (4, 16, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (4, 16, 1, 1, 1), dH=dV=0.5λ |
| BS/RSU deployment for absolute positioning | as per 37.885 | as per 37.885 | as per 37.885 | as per 37.885 |
| BS/RSU deployment for relative positioning/ranging | as per 37.885 | as per 37.885 | as per 37.885 | as per 37.885 |
| Selected values of X (relative positioning or ranging is performed between two UEs within X m) | 250m | 250m | 250m | 250m |
| Assisting UEs | 10 | 10 | 10 | 10 |
| Positioning method | TDOA | TDOA | TDOA | TDOA |

Evaluation cases and relevant additional assumptions for IIoT use cases are provided in Table B.1.16.1-4.

**Table B.1.16.1-4 Assumptions for sidelink positioning for IIoT use cases that are different from or not provided in Annex A.1 from [32]**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameters** | **Case 23, InF-SH, BW-100MHz, InF-SH, FR1, TDOA** | **Case 24 BW 200MHz,**  **InF-SH,**  **FR2, TDOA** | **Case 25, BW 100MHz, InF-DH, FR1, TDOA** | **Case 26 BW#200MHz,**  **InF-DH,**  **FR2, TDOA** |
| UE Antenna model | (M, N, P, Mg, Ng) = (1, 1, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (1 1, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (1, 1, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (1, 1, 1, 1, 1), dH=dV=0.5λ |
| TRP antenna model | (M, N, P, Mg, Ng) = (4, 2, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (4, 2, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (4, 2, 1, 1, 1), dH=dV=0.5λ | (M, N, P, Mg, Ng) = (4, 2, 1, 1, 1), dH=dV=0.5λ |
| BS deployment for absolute positioning | as per 38.857 | as per 38.857 | as per 38.857 | as per 38.857 |
| Carrier Frequency | 3.5 GHz | 28 GHz | 3.5 GHz | 28 GHz |
| Assisting UEs | 10 | 10 | 10 | 10 |
| Positioning method | TDOA | TDOA | TDOA | TDOA |

B.1.16.2 Positioning accuracy evaluation results for Sidelink

B.1.16.2.1 Positioning accuracy evaluation results for Sidelink Positioning for Highway Scenarios for V2X

Table B.1.16.2.1-1 provides horizontal absolute positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases in FR1.

Table B.1.16.2.1-2 provides horizontal absolute positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases in FR2.

Table B.1.16.2.1-3 provides horizontal relative positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases in FR1.

Table B.1.16.2.1-4 provides ranging distance accuracy results using sidelink positioning for highway scenarios for V2X use cases in FR1.

Table B.1.16.2.1-5 provides ranging distance accuracy results using sidelink positioning for highway scenarios for V2X use cases in FR2

**Table B.1.16.2.1-1** Sidelink **positioning - horizontal absolute accuracy for highway scenarios for V2X use cases in FR1 from [32]**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** | **Comment on Best link combination** |
| Case 1, BW-100MHz, TDOA | 0.27 | 0.44 | 0.68 | 1.03 | Yes | 70% | Considering V2X UE + RSU |
| Case 2, BW-40MHz, TDOA, | 0.61 | 0.87 | 1.26 | 1.99 | No | 45% | Considering V2X UE + RSU |
| SL Case 3, BW-20MHz, TDOA, | 0.93 | 1.62 | 2.23 | 4.18 | No | 30% | Considering V2X UE + RSU |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** | **Comment on Best link combination** |
| Case 4, BW-200MHz, TDOA | 0.12 | 0.23 | 0.39 | 0.80 | Yes | 80% | Considering V2X UE + RSU |

**Table B.1.16.2.1-2 Sidelink positioning - horizontal absolute accuracy for highway scenarios for V2X use cases in FR2 from [32]**

**Table B.1.16.2.1-3 Sidelink positioning - horizontal relative accuracy for highway scenarios for V2X use cases in FR1 from [32]**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** | **Comment on Best link combination** |
| Case 5, BW-100MHz, TDOA | 0.28 | 0.40 | 0.65 | 1.01 | Yes | 80 % | Considering V2X UE + RSU |
| Case 6, BW-40MHz, TDOA | 0.60 | 0.92 | 2.07 | 3.84 | 70% | No | Considering V2X UE + RSU |
| Case 7, BW-20MHz, TDOA | 0.96 | 1.52 | 2.42 | 3.59 | 65% | No | Considering V2X UE + RSU |

**Table B.1.16.2.1-4 Sidelink positioning – distance ranging accuracy for highway scenarios for V2X use cases in FR1 from [32]**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** | **Comment on Best link combination** |
| Case 8, BW-100MHz, TDOA | 0.08 | 0.11 | 0.21 | 0.71 | Yes | No | Considering V2XUE |
| Case 9, BW-40MHz, TDOA | 0.26 | 0.86 | 1.76 | 3.02 | No | No | Considering V2XUE |
| Case 10, BW-20MHz, TDOA | 0.32 | 0.58 | 1.29 | 2.40 | No | No | Considering V2XUE |

**Table B.1.16.2.1-5 Sidelink positioning – distance ranging accuracy for highway scenarios for V2X use cases in FR2 from [32]**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** | **Comment on Best link combination** |
| Case 11, BW-200MHz,TDOA | 0.02 | 0.03 | 0.06 | 0.11 | Yes | Yes | Considering V2X UE +RSU |

B.1.16.2.2 Positioning accuracy evaluation results for Sidelink Positioning for Urban Grid Scenarios for V2X

Table B.1.16.2.2-1 provides horizontal absolute positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases in FR1.

Table B.1.16.2.2-2 provides horizontal absolute positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases in FR2.

Table B.1.16.2.2-3 provides horizontal relative positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases in FR1.

Table B.1.16.2.2-4 provides ranging distance accuracy results using sidelink positioning for highway scenarios for V2X use cases in FR1.

Table B.1.16.2.2-5 provides ranging distance accuracy results using sidelink positioning for highway scenarios for V2X use cases in FR2

**Table B.1.16.2.2-1 Sidelink positioning – horizontal absolute positioning accuracy for urban grid scenarios for V2X use cases in FR1 from [32]**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** | **Comment on Best link combination** |
| Case 12, BW-100MHz,TDOA | 0.27 | 0.39 | 0.70 | 1.38 | Yes | 70% | Considering V2X UE +RSU |
| Case 13, BW-40MHz, TDOA, | 0.32 | 0.46 | 0.77 | 1.20 | Yes | 70% | Considering V2X UE +RSU |
| Case 14, BW-20MHz, TDOA, | 0.33 | 0.43 | 0.70 | 1.08 | Yes | 70% | Considering V2X UE +RSU |

**Table B.1.16.2.2-2 Sidelink positioning – horizontal absolute positioning accuracy for urban grid scenarios for V2X use cases in FR2 from [32]**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** | **Comment on Best link combination** |
| Case 15, BW-200M, TDOA, | 0.49 | 0.56 | 1.00 | 1.65 | 80% | 60% | Considering V2X UE +RSU |

**Table B.1.16.2.2-3 Sidelink positioning – horizontal relative positioning accuracy for urban grid scenarios for V2X use cases in FR1 from [32]**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** | **Comment on Best link combination** |
| Case 16, BW-100MHz, TDOA,  V2X UE as a reference | 0.19 | 0.33 | 0.52 | 0.92 | Yes | 80% | Considering V2X UE + RSU |
| Case 17, BW-40MHz, TDOA,  RSU as a reference | 0.30 | 0.45 | 0.75 | 1.45 | Yes | 70% | Considering V2XUE +RSU |
| Case 18, BW-20MHz, TDOA,  RSU as a reference | 0.32 | 0.47 | 0.77 | 1.17 | Yes | 70% | Considering V2XUE + RSU |

**Table B.1.16.2.2-4 Sidelink positioning – distance ranging accuracy for urban grid scenarios for V2X use cases in FR1 from [32]**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** | **Comment on Best link combination** |
| Case 19, BW-100MHz, TDOA | 0.10 | 0.14 | 0.20 | 0.28 | Yes | Yes | Considering V2XUE + RSU |
| Case 20, BW-40MHz, TDOA | 0.11 | 0.16 | 0.20 | 0.30 | Yes | Yes | Considering V2XUE + RSU |
| Case 21, BW-20MHz, TDOA | 0.20 | 0.26 | 0.37 | 0.55 | Yes | Yes | Considering V2XUE + RSU |

**Table B.1.16.2.2-5 Sidelink positioning – distance ranging accuracy for urban grid scenarios for V2X use cases in FR2 from [32]**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** | **Comment on Best link combination** |
| Case 22, BW-200MHz, TDOA | 0.15 | 0.28 | 0.51 | 0.89 | Yes | 80% | Considering V2XUE + RSU |

B.1.16.2.3 Positioning accuracy evaluation results for IIoT

Table B.1.16.2.3-1 provides horizontal absolute positioning accuracy results using sidelink positioning for IIoT for InF-SH scenario in FR1.

Table B.1.16.2.3-2 provides horizontal absolute positioning accuracy results using sidelink positioning for IIoT for InF-SH scenario in FR2.

Table B.1.16.2.3-3 provides horizontal absolute positioning accuracy results using sidelink positioning for IIoT for InF-SH scenario in FR1.

Table B.1.16.2.3-4 provides horizontal absolute positioning accuracy results using sidelink positioning for IIoT for InF-SH scenario in FR1.

Table B.1.16.2**.3-1 Sidelink positioning – horizontal absolute positioning accuracy for IIoT for InF-SH in FR1 from [32]**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** | **Comment on Best link combination** |
| Case 23, BW-100MHz, TDOA | 0.067 | 0.15 | 0.31 | 0.73 | Yes | 70% | Considering Uu +SL |

Table B.1.16.2**.3-2 Sidelink positioning – horizontal absolute positioning accuracy for IIoT for InF-SH in FR2 from [32]**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** | **Comment on Best link combination** |
| Case 24, BW-200MHz, TDOA | 0.003 | 0.005 | 0.012 | 0.025 | Yes | Yes | Considering Uu +SL |

Table B.1.16.2**.3-3 Sidelink positioning – horizontal absolute positioning accuracy for IIoT for InF-DH in FR1 from [32]**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** | **Comment on Best link combination** |
| Case 25, BW- 100MHz, TDOA | 0.08 | 0.18 | 0.42 | 1.17 | Yes | 68% | Uu +SL |

Table B.1.16.2**.3-4 Sidelink positioning – horizontal absolute positioning accuracy for IIoT for InF-DH in FR2 from [32]**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Case ID and brief description** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of set A** | **Whether meet the requirement of set B** | **Comment on Best link combination** |
| Case 26 BW-200MHz, TDOA | 0.011 | 0.025 | 0.07 | 0.19 | Yes | Yes | Uu+SL |

B.1.17 Results from source [34] and [143]

B.1.17.1 Description of evaluation scenarios

Common assumptions applicable to all evaluated scenarios are provided in Table B.1.17.1-1. Additional assumptions for each use case are provided in Table B.1.17.1-2 and Table B.1.17.1-3.

**Table B.1.17.1-1: Common assumptions for sidelink positioning evaluations [34] and [143]**

|  |  |
| --- | --- |
| **Parameter** |  |
| Carrier frequency | 4GHz (Uu), 6GHz (SL) |
| Subcarrier spacing | 30 kHz |
| Reference Signal Transmission Bandwidth | [10 20 100] MHz |
| Reference Signal Physical Structure and Resource Allocation (RE pattern) | - |
| Reference signal including PRS, SRS and SL-PRS  (type of sequence, number of ports, …) | SRS (SL,UL): 2 symb, 4 comb  PRS (DL): comb 12 |
| Number of symbols used per occasion | (see above) |
| number of occasions used per positioning estimate | 1 |
| Power-boosting level | - |
| Uplink power control (applied/not applied) | - |
| interference modelling (ideal muting, or other) | No interference modelled |
| Description of Measurement Algorithm (e.g. super resolution, interference cancellation, ….) |  |
| Description of positioning technique / applied positioning algorithm (e.g. Least square, Taylor series, etc) | Robust least square |
| Synchronization assumptions | Perfect sync |
| UE/gNB RX and TX timing error assumption | Perfect timing |
| Precoding assumptions (codebook, nrof antenna elements used, etc) | Assume single dual polarized antenna element |
| Additional notes, if any |  |

**Table B.1.15.1-2: Additional assumptions for V2X highway scenario, absolute Positioning**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 1 | Case 2 | Case 3 | Case 4 | Case 5 |
| Frequency Range | FR1 | FR1 | FR1 | FR1 | FR1 |
| Bandwidth | 10MHz | 20MHz | 100MHz | 10MHz | 20MHz |
| Positioning method | TDOA | TDOA | TDOA | RTT | RTT |
| **Parameters** | Case 6 | Case 7 | Case 8 | Case 9 |  |
| Frequency Range | FR1 | FR1 | FR1 | FR1 |  |
| Bandwidth | 100MHz | 10MHz | 20MHz | 100MHz |  |
| Positioning method | RTT | RTT, hybrid Uu+SL | RTT, hybrid Uu+SL | RTT, hybrid Uu+SL |  |

**Table B.1.15.1-3: Additional assumptions for V2X highway scenario, ranging**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | Case 10 | Case 11 | Case 12 | Case 13 | Case 14 | Case 15 |
| Frequency Range | FR1 | FR1 | FR1 | FR1 | FR1 | FR1 |
| Bandwidth | 10MHz | 20MHz | 100MHz | 10MHz | 20MHz | 100MHz |
| Positioning method | RTT | RTT | RTT | TA – One way ranging | TA – One way ranging | TA – One way ranging |

B.1.17.2 Positioning accuracy evaluation results for Sidelink Positioning

B.1.17.2.1 Positioning accuracy evaluation results for Sidelink Positioning for Highway Scenarios for V2X

Table B.1.17.2.1-1 provides horizontal absolute positioning accuracy results using sidelink positioning for highway scenarios for V2X use cases.

Table B.1.17.2.1-2 provides ranging distance accuracy results using sidelink positioning for highway scenarios for V2X use cases.

**Table B.1.17.2.1-1: Sidelink positioning - ranging distance accuracy for highway scenarios for V2X use cases from [34] and [143]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of Set A** | **Whether meet the requirement of Set B** |
| Case 1 BW#10M, FR#1, #TDOA | 1.4 | 2.1 | 3.1 | 4.5 | No (54%) | No (12%) |
| Case 2 BW#20M, FR#1, #TDOA | 1.0 | 1.6 | 2.3 | 3.5 | No (64%) | No (18%) |
| Case 3 BW#100M, FR#1, #TDOA | 0.2 | 0.3 | 0.5 | 0.7 | Yes | No (81%) |
|  |  |  |  |  |  |  |
| Case 4 BW#10M, FR#1, #RTT | 1.4 | 2.1 | 3.1 | 4.5 | No (54%) | No (12%) |
| Case 5 BW#20M, FR#1, #RTT | 1.0 | 1.6 | 2.3 | 3.5 | No (64%) | No (18%) |
| Case 6 BW#100M, FR#1, #RTT | 0.2 | 0.3 | 0.5 | 0.7 | Yes | No (81%) |
| Case 7 BW#10M, FR#1, #RTT, HYBRID Uu+SL | 0.9 | 1.2 | 1.6 | 2.2 | No (76%) | No (26%) |
| Case 8 BW#20M, FR#1, #RTT, HYBRID Uu+SL | 0.5 | 0.7 | 0.9 | 1.3 | Yes | No (52%) |
| Case 9 BW#100M, FR#1, #RTT, HYBRID Uu+SL | 0.1 | 0.15 | 0.2 | 0.3 | Yes | Yes |

**Table B.1.17.2.1-2: Sidelink positioning - - horizontal absolute accuracy for highway scenarios for V2X use cases from [34] and [143]**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case** | **50%** | **67%** | **80%** | **90%** | **Whether meet the requirement of Set A** | **Whether meet the requirement of Set B** |
| Case 10 BW#10M, FR#1, #RTT | 0.9 | 1.4 | 2.0 | 3.3 | No (68%) | No (32%) |
| Case 11 BW#20M, FR#1, #RTT | 0.7 | 1.1 | 1.6 | 2.5 | No (78%) | No (40%) |
| Case 12 BW#100M, FR#1, #RTT | 0.2 | 0.3 | 0.4 | 0.7 | Yes | No (86%) |
| Case 13 BW#10M, FR#1, #TA-OWR | 4.1 | 6.6 | 9.5 | 14.5 | No (20%) | No (6%) |
| Case 14 BW#20M, FR#1, #TA-OWR | 2.9 | 4.8 | 8.0 | 12.9 | No (29%) | No (10%) |
| Case 15 BW#100M, FR#1, #TA-OWR | 1.4 | 2.4 | 3.7 | 6.9 | No (51%) | No (25%) |

# B.2 Evaluation results for integrity for RAT-dependent positioning techniques

## B.2.1 Results from source [133], [134]

### B.2.1.1 Description of evaluation scenarios

Details related to evaluation scenarios can be found in [133] and [134].

### B.2.1.2 Evaluation results related to the distribution of measurement error

Details of the evaluation results related to the distribution of timing measurement error can be found in [133].

Details of the evaluation results related to the distribution of angle measurement error can be found in [133] and [134].

## B.2.2 Results from source [135]

### B.2.2.1 Description of evaluation scenarios

Details related to evaluation scenarios can be found in [135].

### B.2.2.2 Evaluation results related to the distribution of measurement error

Details of the evaluation results related to the distribution of timing measurement error can be found in [135].

Details of the evaluation results related to the distribution of angle measurement error can be found in [135].

## B.2.3 Results from source [136]

### B.2.3.1 Description of evaluation scenarios

Details related to evaluation scenarios can be found in [136].

### B.2.3.2 Evaluation results related to the distribution of measurement error

Details of the evaluation results related to the distribution of timing measurement error can be found in [136].

## B.2.4 Results from source [137], [138]

### B.2.4.1 Description of evaluation scenarios

Details related to evaluation scenarios can be found in [137] and [138].

### B.2.4.2 Evaluation results related to the distribution of measurement error

Details of the evaluation results related to the distribution of timing measurement error can be found in [137] and [138].

Details of the evaluation results related to the distribution of angle measurement error can be found in [137] and [138].

## B.2.5 Results from source [139]

### B.2.5.1 Description of evaluation scenarios

Details related to evaluation scenarios can be found in [139].

### B.2.5.2 Evaluation results related to the distribution of measurement error

Details of the evaluation results related to the distribution of timing measurement error can be found in [139].

## B.2.6 Results from source [141]

### B.2.6.1 Description of evaluation scenarios

Details related to evaluation scenarios can be found in [141].

### B.2.6.2 Evaluation results related to the distribution of measurement error

Details of the evaluation results related to the distribution of timing measurement error can be found in [141].

## B.2.7 Results from source [142]

### B.2.7.1 Description of evaluation scenarios

Details related to evaluation scenarios can be found in [142].

### B.2.7.2 Evaluation results related to the distribution of measurement error

Details of the evaluation results related to the distribution of timing measurement error can be found in [142].

Details of the evaluation results related to the distribution of angle measurement error can be found in [142].

# B.3 Void