

vivo



**3GPP TSG-RAN WG Meeting #90-e
e-Meeting, December 7th–11th, 2020
Agenda Item: 9.1.1
Document for: Discussion & Decision**

RP-202639

WID scope for Rel-17 ePositioning

- Prioritize the recommended enhancement from WG discussion
- Aspects that need further study can be considered later dependent on progress of recommended enhancement
- Covering the four aspects explicitly mentioned in the SID with balanced scope
 - Device efficiency, high accuracy, low latency, network efficiency

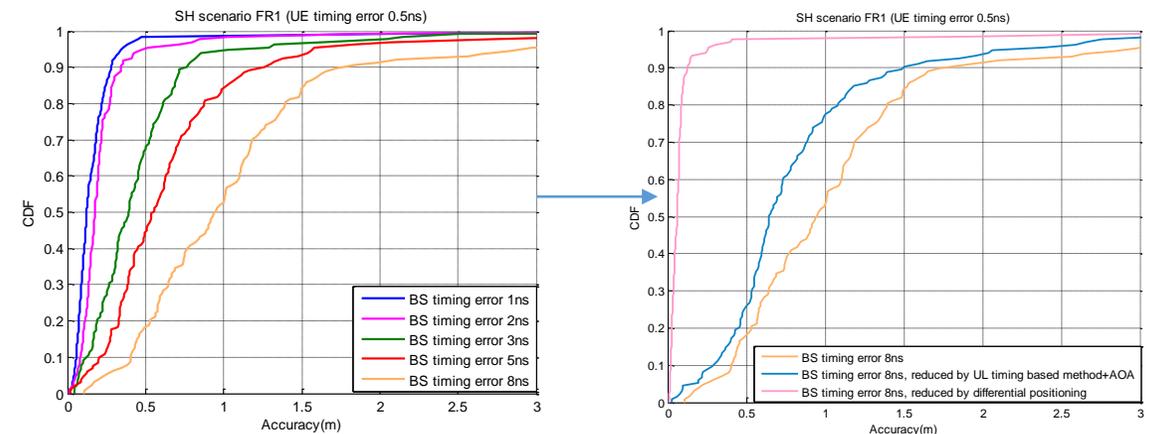
- The following items are recommended from RAN1
 - NR positioning for UEs in RRC_INACTIVE state
 - Including DL positioning measurement in RRC_IDLE state
 - LMF/UE-initiated on-demand transmission and reception of DL PRS
 - The methods, measurements, signaling, and procedures for mitigating the UE Rx/Tx timing delays, and/or and gNB Rx/Tx timing delays
 - The enhancements of the procedure, measurements, reporting, and signalling for improving the accuracy of UL-AoA and DL-AoD positioning solutions
 - Enhancements of signalling & procedures for reducing NR positioning latency, including enhancements on the measurement gap, measurement request and reporting (e.g. via RRC signaling, MAC-CE and/or physical layer procedure, and/or priority rules), the measurement time
- **All recommended enhancements should be captured into positioning enhancement WID.**

- Observations from study
 - Positioning measurement and report in the idle/inactive state can obtain at least **48.38% power saving gain**, compared to positioning measurement and report all in the connected state
 - Positioning report in the idle/inactive state can obtain **44.32% power saving gain** compared to report in connected, under the premise of idle/inactive state measurement
 - DL positioning measurement in RRC idle state is feasible
 - It is natural to enable this feature in NR, since idle state measurement has already been supported in LTE for NB-IoT UEs
 - Small specification impact
- The following should be included in the WID scope:
 - **Specify NR positioning for UEs in RRC_INACTIVE state, including**
 - **PRS measurement and report in RRC_INACTIVE state**
 - **SRS transmission in RRC_INACTIVE state**
 - **Specify DL positioning measurement in RRC_IDLE state**

- Observations from study
 - On-demand corresponds to the UE-initiated or network-initiated request of PRS, including UE or LMF request/suggesting/recommending specific PRS pattern, ON/OFF, periodicity, BW, etc.
 - The network and device efficiency can be improved by on-demand PRS (assuming the same latency) compared to periodic PRS
 - The latency will be reduced considering on-demand PRS may reduce the alignment time of periodic PRS
- The following should be including in the WID scope:
 - **Specify LMF/UE-initiated on-demand transmission and reception of DL PRS**

- Observations from study
 - Estimated minimum DL PRS measurement time in Rel.16 can be 88.5ms depending on DL PRS configuration settings
 - The following list provides the major physical layer latency components for Rel.16 DL TDOA/DL-AOD UE-assisted NR Positioning
 - DL PRS alignment, transmission, measurement (including processing time) and report delay. Enhancements at least include aperiodic PRS, prioritized PRS measurement and PRS reporting.
 - Measurement gap request, configuration and alignment time. Enhancements at least include PRS measurement without MG, enhancement for MG.
 - UE/gNB higher layer (LPP/RRC) processing times. This aspect at least includes enhancement on reporting and requesting measurement and assistance data.
- The following should be included in the WID scope:
 - **Specify enhancements of signaling & procedures for reducing NR positioning latency, including**
 - **PRS measurement without MG or with low layer triggering MG**
 - **The enhancement of measurement requesting and reporting, including:**
 - **RRC signaling, MAC-CE and/or physical layer procedure**
 - **Priority rules for PRS reporting**
 - **The measurement time**

- Observations from study
 - The impact of gNB/UE TX/RX timing errors on NR positioning accuracy were investigated. Evaluation results show the gNB/UE TX/RX timing errors have significant impact on positioning accuracy.
 - The methods proposed by some sources can mitigate gNB/UE TX/RX timing errors, at least includes
 - Differential positioning
 - UL timing-based method+AOA
 - Machine learning
- The following should be included in the WID scope:
 - **Specify methods, measurements, signaling and procedures for mitigating the UE Rx/Tx timing delays, and/or and gNB Rx/Tx timing delays**



- The following items could be further studied later dependent on the progress of recommended issues:
 - **High priority**
 - Aperiodic reception of DL PRS from the TRPs of the serving gNB and aperiodic reception of DL PRS from the TRPs of the neighbouring gNBs
 - Enhancements of signaling&procedures for reducing latency
 - the request and response of positioning assistance data (e.g., via RRC signaling, MAC-CE and/or physical layer procedure)
 - the reception of DL PRS (e.g., priority rules for the reception of DL PRS)
 - **Medium priority**
 - Semi-persistent reception of DL PRS from the TRPs of the serving gNB and Semi-persistent reception of DL PRS from the TRPs of the neighbouring gNBs
 - **Low priority**
 - Enhancements of information reporting from UE and gNB for supporting multipath/NLOS mitigation
 - Simultaneous transmission by the gNB and aggregated reception by the UE of intra-band one or more contiguous carriers in one or more contiguous PFLs
 - Simultaneous transmission by the UE and aggregated reception by the gNB of the SRS for positioning in multiple contiguous intra-band carriers

- Observations from study
 - Estimated minimum DL PRS measurement time in Rel.16 can be **88.5ms** depending on DL PRS configuration settings, which cannot achieve the physical-layer latency requirement of **10ms**.
 - Majority of sources consider it is beneficial to support a-periodic transmission and reception of DL PRS for reducing positioning latency.
 - From evaluation of some sources, the physical layer latency can be reduced by nearly 20ms by aperiodic PRS.
 - Aperiodic PRS is one of the most important methods to reduce the physical layer delay, especially for latency caused by DL PRS alignment.
- **The aperiodic PRS is recommended as high priority to be studied further in positioning enhancement WI phase, depending on progress of recommended enhancement .**

- Observation from study
 - The gain of LOS/NLOS identification is unclear compared with implementation-based solutions.

Agreement:

- Comparative analysis of LOS/NLOS identification with specification changes vs implementation based methods (outlier rejection algorithms) was done by 6 sources (Intel, Huawei, vivo, Qualcomm, ZTE, Oppo)
 - Three sources (Intel, Huawei, ZTE) observe that NR positioning based on LOS/NLOS identification outperforms NR positioning utilizing outlier rejection
 - Three sources (vivo, Qualcomm, Oppo) observe that NR positioning utilizing outlier rejection outperforms NR positioning utilizing LOS/NLOS identification
- The specification effort may be large with current (quite a few) candidate solutions on table.

Agreement:

- Enhancements of information reporting from UE and gNB for supporting multipath/NLOS mitigation can be studied further, and if needed, specified during normative work for improving positioning accuracy.
 - Note: The details of the enhancements of reporting are left for further discussion in normative work, which may include, but are not limited to the following information associated with multi-path, e.g., LOS/NLOS identification, time of arrival of the multi-path components, signal power and/or relative power, power delay profile, angle, and/or polarization information, coherence bandwidth, etc.
- **The enhancements of information reporting for multipath/NLOS mitigation should be treated as low priority in positioning enhancement WI phase.**

- Observations from study:
 - In FR2, the 0.2m target is achieved without PRS&SRS aggregation by most companies
 - **Agreement:** For the case without modeling synchronization and gNB/UE TX/RX timing errors in the InF-SH scenario. For NR positioning evaluations in FR2 band, the following is observed with respect to horizontal positioning accuracy:
 - Accuracy of $\leq 0.2m @ 90\%$ is achieved in contributions from [6] sources and is not achieved in contributions from [3] sources
 - Accuracy of $\leq 0.5m @ 90\%$ is achieved in contributions from [8] sources and is not achieved in contributions from [1] sources
 - In FR1, most companies meet the relaxed requirement of 0.5m and some companies can meet the requirement of 0.2m
 - **Agreement:** For the case without modeling synchronization and gNB/UE TX/RX timing errors in the InF-SH scenario. For NR positioning evaluations in FR1 band, the following is observed with respect to horizontal positioning accuracy:
 - Accuracy of $\leq 0.2m @ 90\%$ is achieved in contributions from [3] sources and is not achieved in contributions from [9] sources
 - Accuracy of $\leq 0.5m @ 90\%$ is achieved in contributions from [7] sources and is not achieved in contributions from [5] sources
 - Application scenarios for the RS aggregation is unclear
 - Even if in ideal condition, it is not clear that the performance requirement can be achieved by limited bandwidth of intra-band continuous CA in FR1.
 - The accuracy benefit is impacted by timing offset, channel spacing and phase offset between PFLs.
 - Study and normative work requires large efforts not only from RAN1 but also from other WGs.
 - The applicability and feasibility for PRS&SRS aggregation need to be studied further
 - Impairment model need further discussion in RAN4
- **PRS&SRS aggregation should be treated as low priority in positioning enhancement WI phase.**

1. Study enhancements and solutions necessary to support the **high accuracy** (horizontal and vertical), **low latency**, **network efficiency** (scalability, RS overhead, etc.), and **device efficiency** (power consumption, complexity, etc.) requirements for commercial uses cases (incl. general commercial use cases and specifically (I)IoT use cases as exemplified in section 3 above (Justification)):
 - a. Define additional scenarios (e.g. (I)IoT) based on TR 38.901 to evaluate the performance for the use cases (e.g. (I)IoT). [RAN1]
 - b. Evaluate the achievable positioning accuracy and latency with the Rel-16 positioning solutions in (I)IoT scenarios and identify any performance gaps. [RAN1]
 - c. Identify and evaluate positioning techniques, DL/UL positioning reference signals, signalling and procedures for improved accuracy, reduced latency, network efficiency, and device efficiency.
Enhancements to Rel-16 positioning techniques, if they meet the requirements, will be prioritized, and new techniques will not be considered in this case. [RAN1, RAN2]
2. Study solutions necessary to support integrity and reliability of assistance data and position information: [RAN2]
 - a. Identify positioning integrity KPIs and relevant use cases.
 - b. Identify the error sources, threat models, occurrence rates and failure modes requiring positioning integrity validation and reporting.
 - c. Study methodologies for network-assisted and UE-assisted integrity.

THANK

YOU