3GPP TSG-RAN WG1 Meeting #103-e R1- 2009417

e-Meeting, October 26th– November 13th, 2020

Agenda Item: 8.5.1

Source: Moderator (Ericsson)

Title: Output #2 of [103-e-NR-ePos-01] Email discussion on additional scenarios for evaluation

Document for: Discussion, Decision

# Introduction

This document presents the outcome of the email discussion triggered under agenda 8.5.1 of RAN1#103e:

[103-e-NR-ePos-01] Email discussion/approval on additional scenarios for evaluation and TR updates until 11/4; address any remaining aspects by 11/12 – Florent (Ericsson)

 The proposals in the contributions centered on the following topics, for which discussion tracks are provided:

* Definition of UE based latency
* Requirements for commercial and IIOT use cases
* UE efficiency
* Network Efficiency
* Further modelling assumptions

# Remaining issues

## Definition of UE based latency

### Summary and initial proposal

During RAN1#102e, 3 alternatives where given for the definition of the starting time of physical layer latency for UE based positioning:

* Alt. 1: transmission of the PUSCH carrying the MG Request from the UE.
* Alt. 2: Transmission of the PDSCH from the gNB carrying the LPP message containing the assistance data
* Alt. 3: Start of the Reception of DL PRS

The following support was expressed in contributions:

* Alt. 1: [8] 13] (UE in RRC connected state) [14]
* Alt. 2: [1] [3] (with modification) [9][12]
* Alt. 3: [13] (UE in RRC idle/inactive state)

Additionally, [1] proposed including the gap request in the physical latency analysis when it is needed. Additional gap are proposed to be taken into account when the RRM measurement gap does not cover the need for PRS measurement gaps [1].

|  |  |
| --- | --- |
| source | proposal |
| [1] | ***Observation 1: The following definition of physical layer latency for UE-based positioning methods is more suited.***

|  |  |  |
| --- | --- | --- |
| UE-based | Transmission of the PDSCH from the gNB carrying the LPP Request Location Information if applicable, otherwise, transmission of the PDSCH from the gNB carrying the message containing the assistance data | Successful decoding of the PUSCH at gNB carrying the LPP Provide Location Information message if applicable, otherwise Calculation of Location Estimate at the UE  |

***Observation 4: The following assumptions are suited for evaluating the latency with respect to measurement gaps.***

|  |  |  |  |
| --- | --- | --- | --- |
| Case | PRS periodicity | Whether a gap is needed | CSSF for PRS |
| No existing RRM gap | Any | Yes | 1 |
| With existing gap | <=20ms | Yes | 2 |
| >=160ms | No | 1 |

 |
| [3] | ***Proposal 2****:* *Alt.2 is used to define Physical Layer Latency Start time for UE based method, i.e.*

|  |  |  |
| --- | --- | --- |
| **Method** | **Start** | **End** |
| UE-based | Transmission of the PDSCH from the gNB carrying the LPP Request Location Information if applicable, otherwise, transmission of the PDSCH from the gNB carrying the LPP message containing the assistance data | Successful decoding of the PUSCH at gNB carrying the LPP Provide Location Information message if applicable, otherwise Calculation of Location Estimate at the UE  |

 |
| [8] | Proposal 1: For physical layer latency of UE-based method, select Alt1 as the start time when PDSCH carrying LPP request location is not appliable.  |
| [9] | **Proposal 2**: For UE based methods, set the start of the PHY layer latency as the moment of *transmission of the PDSCH from the gNB carrying the LPP message containing the assistance data* (Alt. 2 from prior agreement). |
| **[12]** | **Proposal 1 : For UE-based positioning, support Alt. 2, “Transmission of the PDSCH from the gNB carrying the LPP message containing the assistance data”, as the start time for the physical layer latency analysis** |
| **[13]** | ***Proposal 1: With regards to the “start time” of the PHY-layer latency for UE-based method initiated by an internal client,*** * ***For a UE in RRC connected state, Alt 1 should be considered as the start time***
* ***For a UE in RRC Idle/inactive state, Alt. 3 should be considered as the start time***
 |
| [14] | **For UE based positioning, the start time for physical latency evaluation is defined asthe transmission of the PUSCH carrying the MG Request from the UE (Alt. 1).** |

Based on the submitted contributions, there is no consensus yet on on what alternative to use for the definition of the starting time for physical latency of UE based methods. It should be noted, however, that the meeting is the last one scheduled for the SI. Hence we should not expect companies to be able to impact their TR results based on the chosen alternative. Thus we propose the following way forward:

**Feature lead proposal: For UE based positioning solutions, the definition of physical layer latency starting time is:**

* **Option1: up companies to chose between alt 1, alt 2 or alt 3 in the agreement from RAN1#102e**
* **Option 2: to be further discussed during RAN1#103e**

Companies are encouraged to provide their views in the table below and state their preference in terms of alt1, alt2, alt3 in case option 2 is chosen.

|  |  |
| --- | --- |
| Company | Comment |
| Futurewei | Option 1 |
| Nokia/NSB | Option 1 |
| OPPO | It is preferred to have a unified definition. We have clear definition of starting time for all the other scenarios, why leaving companies to choose only for this scenaro?  |
| ZTE | Option 2. Unified definition is preferred. |
| CATT | Option 2. We prefer to have a common definition of physical latency starting time for UE based positioning method.Alt-2 is our preference (i.e., Transmission of the PDSCH from the gNB carrying the LPP message containing the assistance data). |
| Huawei/HiSilicon | We can accept Option 1.In addition, we had the observation on how gap request and gap sharing are connected for latency analysis. We assume that it is also up to each company to report. |
| Lenovo, Motorola Mobility | We ideally prefer Option 2- Alt1 for comparative fairness against UE-assisted methods since UE assistance data configuration latency (e.g. PDSCH carrying LPP ProvideAssistanceData message) was also excluded for UE-assisted methods. However, given the time constraints we are also fine with Option 1 and acknowledge that there may be a variation in PHY latency range values for UE-B positioning in the TR among different companies. |
| vivo | Option1 |
| LG | We prefer option 2 and Alt 1. As you all know, assistance data transfer procedure is nomally considered as previous step than LPP Request Location Information transfer procedure. And then, we think that the case when LPP Request Location Information is not applicable includes UE-initiated Location Information Delivery procedure in accordance with 8.2.3.3.2 in 38.805. So, transmission of the PUSCH(MG Request) from UE should be start time to measure PRS. |
| Fraunhofer | Option 1 |

### Update#1 after first round of comments

There are five companies which are fine with leaving it to companies to present what alternative was used in their evaluations. 3 companies support to use Alt1 as a definition, 1 companies prefers alt2 and 2 other companies have not expressed their preference. Given that there is not a clear preference yet, the FL proposal is reiterated below to see if further discussion clarifies the situation

**Feature lead proposal: For UE based positioning solutions, the definition of physical layer latency starting time is:**

* **Option1: up companies to choose between alt 1, alt 2 or alt 3 in the agreement from RAN1#102e**
* **Option 2: to be further discussed during RAN1#103e**

Companies are encouraged to provide their views in the table below

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Option1 is preferred because of the tight timeline |
| CATT | Option 2.We prefer to have a common definition of physical latency starting time for UE based positioning method. |
| Nokia/NSB | We of course have our own preference for an alternative but given that we are at the end of the first week and already need to draw observations/conclusions to finish the study we suggest Option 1 and ask other companies to consider this as well. In fact option 1 is already done given the contributions to this meeting.  |
| ZTE | Although we prefer to have unified definition, we can accept the to support Alt2 and Alt3 * Alt. 2: (UE in RRC connected state)
* Alt. 3: (UE in RRC idle/inactive state)
 |
| LG | Even though we mentioned that we prefer to make unified definition, we are running out of time, so we are also fine with the option 1 and hopeffully the progress will go smoothly. |
| InterDigital | Option 1. In latency analysis, the purpose is to identify the bottleneck component that causes latency in a positioning method. Thus, for each alternative it is possible to identify the common bottleneck component with other techniques, such as UE assisted DL positioning methods. The companies can report which alternative they assumed, and through the latency analysis, the group can list candiate bottleneck components. The group should identify the common latency problems that exist across all positioning methods. |

## Requirements for commercial and IIOT use cases

### Summary and initial proposal

During RAN1#101e, an agreement was made on requirements for commercial and IIOT use cases, with open issues to resolve regarding the accuracy and latency requirements as well as the applicable percentile points for these requirements. During RAN1#102e, the discussion continued but did not converge.

The following views was expressed for the requirements:

Commercial use cases:

* Horizontal accuracy
	+ 1m @ 90% of UEs: [2], [3], [8][10] [11] (SL1,2) )[14]
	+ 1m @ 85% of UEs: [4]
	+ 1m @ 80% of UEs: [6]
* Vertical accuracy
	+ 3m @ 90% of UEs: [2], [3], [8], [10], [11] (SL2)
	+ 3m @ 85% of UEs: [4]
	+ 3m @ 80% of UEs: [6]
	+ 2m @90% of UEs [11] (SL1)
* End to end latency
	+ 100ms: [2] ,[3], [4], [6], [8] )[14]
* Physical layer latency
	+ 10ms: [2] ,[3], [4],
	+ 100ms [6] )[14]
	+ 25ms [8]

IIOT use cases:

* Horizontal accuracy
	+ 0.2m @ 90% of UEs: [2] [3], [4], [6], [7] (for SH), [10], [11] (SL1,2)[14]
	+ 0.5m @90% of UEs: [3], [6], [7](for DH), [8], [11] (SL3)
* Vertical accuracy
	+ 1m @ 90% of UEs: [2], [4], [6], [7](for DH), [8], [10], [11] (SL2,3) )[14]
	+ 0.2m @ 90% of UEs: [3], [6], [7] (for SH), [11] (SL1)
* End to end latency
	+ 100ms: [2] , [3], [4], [7], [8] [11] (SL3) )[14]
	+ 10ms: [6], [11] (SL1)
	+ 25ms [8]
	+ 20ms [11] (SL2)
* Physical layer latency
	+ 10ms: [2] , [3], [4], [6], [7], [11] (SL1,2,3) )[14]

|  |  |
| --- | --- |
| source | proposal |
| [2] | ***Proposal 1:*** * ***In Rel-17 the target positioning requirements should be independent of use cases and service level.***

***Proposal 2:*** * ***In Rel-17 target positioning requirements for commercial use cases are defined as follows:***
	+ ***Horizontal position accuracy (< 1 m) for ~~[~~90%~~]~~ of UEs***
	+ ***Vertical position accuracy (< ~~[2 or~~ 3~~]~~ m) for ~~[~~90%~~]~~ of UEs***
	+ ***End-to-end latency for position estimation of UE (< ~~[~~100 ms~~]~~)***
	+ ***~~FFS:~~ Physical layer latency for position estimation of UE (< [10 ms])***
* ***In Rel-17 target positioning requirements for IIoT use cases are defined as follows:***
	+ ***Horizontal position accuracy (< X m) for ~~[~~90%~~]~~ of UEs***
		- ***X = ~~[~~0.2 ~~or 0.5]~~ m***
	+ ***Vertical position accuracy (< Y m) for ~~[~~90%~~]~~ of UEs***
		- ***Y = ~~[0.2 or~~ 1~~]~~ m***
	+ ***End-to-end latency for position estimation of UE (< ~~[10ms, 20ms, or~~ 100ms~~]~~)***
	+ ***~~FFS:~~ Physical layer latency for position estimation of UE (< ~~[~~10ms~~]~~)***

***Note: Target positioning requirements may not necessarily be reached for all scenarios.*** |
| [3] | ***Proposal 1:*** *Adopt following target accuracy requirements for Rel-17** *For commercial use cases:*
	+ *Horizontal position accuracy (< 1 m) for 90% of UEs*
	+ *Vertical position accuracy (< 3 m) for 90% of UEs*
* *For IIoT use cases:*
	+ *Horizontal position accuracy (< X m) for 90% of UEs*
		- *X = 0.2 or 0.5 m*
	+ *Vertical position accuracy (< Y m) for 90% of UEs*
		- *Y = 0.2 or 1 m*
 |
| [4] | ***Proposal 1:*** ***We prefer the following numbers for Rel-17 target positioning requirements:******In Rel-17 target positioning requirements for commercial use cases are defined as follows:**** ***Horizontal position accuracy (< 1 m) for X1 of UEs***
	+ ***X1 = 85%***
* ***Vertical position accuracy (< 3 m) for X2 of UEs***
	+ ***X2 = 85%***
* ***End-to-end latency for position estimation of UE (< X3)***
	+ ***X3 = 100ms***
* ***Physical layer latency for position estimation of UE (< X4)***
	+ ***X4 = 10ms***

***In Rel-17 target positioning requirements for IIoT use cases are defined as follows:**** ***Horizontal position accuracy (< X5) for 90% of UEs***
	+ ***X5 = 0.2m***
* ***Vertical position accuracy (< X6) for 90% of UEs***
	+ ***X6 = 1m***
* ***End-to-end latency for position estimation of UE (< X7)***
	+ ***X7 = 100ms***
* ***Physical layer latency for position estimation of UE (< X8)***
	+ ***X8 = 10ms***
 |
| [6] | * + **For the accuracy and latency requirements, we suggest defining X1 = 80 %, X2 = 80 %, X3 = 100 ms, X4 = (0.2 m or 0.5 m), X5 = (0.2 m or 1 m), X6 = 10 ms, X7 = 10 ms**
 |
| [8] | *Proposal 2: Propose to adopt the following performance requirement for Rel-17 positioning:*

|  |
| --- |
| * **In Rel-17 target positioning requirements for commercial use cases are defined as follows:**
	+ **Horizontal position accuracy (< 1 m) for 90% of UEs**
	+ **Vertical position accuracy (< 3 m) for 90% of UEs**
	+ **End-to-end latency for position estimation of UE (< 100 ms)**
	+ **Physical layer latency for position estimation of UE (< 25 ms)**
* **In Rel-17 target positioning requirements for IIoT use cases are defined as follows:**
	+ **Horizontal position accuracy (< 0.5 m) for 90% of UEs**
	+ **Vertical position accuracy (< 1 m) for 90% of UEs**
	+ **End-to-end latency for position estimation of UE (<100ms)**
	+ **FFS: Physical layer latency for position estimation of UE (< 25ms)**
 |

 |
| [10] | **Proposal 1: Our preferred positioning accuracy requirements:** * **In Rel-17 target positioning requirements for commercial use cases are defined as follows:**
* **Horizontal position accuracy (< 1 m) for 90%of UEs**
* **Vertical position accuracy (<3m) for 90% of UEs**
* **In Rel-17 target positioning requirements for IIoT use cases are defined as follows:**
* **Horizontal position accuracy (< 0.2 m) for 90%of UEs**
* **Vertical position accuracy (< 1 m) for 90% of UEs**

 Proposal 2: Support different service level in which each level represent both positioning accuracy and latency. **Proposal 3: Define the end-to-end positioning latency after receiving the associated LS response from RAN2 as this requirement is beyond RAN1 scope.** |
| [11] | ***Proposal 1:**** RAN 1 should adopt following table for accuracy and latency requirements:

Table 1. Target positioning requirements for commercial and IIOT use cases

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Service level****Requirement** | **Commercial– SL1** | **Commercial– SL2** | **IIoT - SL1** | **IIoT - SL2** | **IIoT – SL3** |
| **Horizontal position accuracy** | < 1 m for 90% of UEs | < 1 m for: 90% of UEs | <0.2m for 90% of UEs | <0.2m for 90% of UEs | <0.5m for 90% of UEs |
|  **Vertical position accuracy** | < 2 m for 90% of UEs | < 3 m for 90% of UEs | <0.2m for 90% of UEs | <1m for 90% of UEs | <1m for 90% of UEs |
| **End-to-end latency** | <100ms | <100ms | <10ms  | **<**20ms  | <100ms  |
| **Physical layer latency** | <10ms | <10ms | <10ms  | <10ms  | <10ms  |

* Note 1: All positioning techniques do not need to achieve the target positioning requirements over all scenarios.
* Note 2: End-to-end latency requirements can be changed depending on a response LS from other WGs.
 |
|  |  |

Based on the submitted contributions, there is no complete consensus on the values to use for requirements. There are however quite a lot of companies agreeing for most of the requirements.

The following proposal is based on the majority of the companies:

**Feature lead proposal:**

* **In Rel-17 target positioning requirements for commercial use cases are defined as follows:**
	+ **Horizontal position accuracy (< 1 m) for 90% of UEs**
	+ **Vertical position accuracy (< 3 m) for 90% of UEs**
	+ **End-to-end latency for position estimation of UE (< 100 ms)**
	+ **Physical layer latency for position estimation of UE (< 10 ms)**
* **In Rel-17 target positioning requirements for IIoT use cases are defined as follows:**
	+ **Horizontal position accuracy (< X m) for 90% of UEs**
		- **X = 0.2 or 0.5 m**
	+ **Vertical position accuracy (< Y m) for [90%] of UEs**
		- **Y =0.2 or 1 m**
	+ **End-to-end latency for position estimation of UE (<100ms)**
	+ **FFS: Physical layer latency for position estimation of UE (<10ms)**
* **Note: Target positioning requirements may not necessarily be reached for all scenarios**

Companies are encouraged to provide their views in the table below

|  |  |
| --- | --- |
| Company | Comment |
| Nokia/NSB | We should not rewrite the SID (which has very clear requirements in our view). We already have the note that these may not be reached for all scenarios so don’t see the benefit of having multiple accuracies.  |
| OPPO | Considering the different maximal BW in FR1 and FR2, one wayforward is to set the position accuracy as follows: * For FR1: X = 0.5m
* For FR2: X = 0.2m
 |
| ZTE | Agree with the proposal. |
| CATT | We can agree the FL proposal with X=0.2m and Y=1m. It looks like we don’t need multiple values for accuracy, since target positioning requirements may not necessarily be reached for all scenarios. |
| Huawei/HiSilicon | For IIOT horizontal accuracy, we do not think 0.2m is feasible when the product impairment (sync error) is taken into account, and thus 0.5m should be more appropriate to provide guidance on achievable accuracy to the industry. |
| Lenovo, Motorola Mobility | Multiple accuracies for IIoT may be ambiguous if an associated scenario applicable to the accuracy is not defined. It was observed from the companies’ evaluations that the PHY latencies may vary depending on the configured positioning technique, e.g. DL-based, UL-based or DL+UL-based methods. Similar case for accuracy evaluations. Suggest that this aspect could be reflected in an additional note, e.g. Note 1 from LG[1]:Note: “All positioning techniques may not ~~need to~~ achieve the target positioning requirements over all scenarios” |
| CMCC | Do NOT support to have multiple values, it would cause confusion on how to capture the evaluation results and identify the performance gap.Agree with Nokia that the accuracy justified in the SID should be kept, at least for the horizontal value. For the vertical one, according to the results provided by companies, we are ok to 1m. |
| vivo | Agree with Nokia and CMCC, one accuracy is enough with the note. And the accuracy can be set as:* X = 0.2m
* Y=1m

And maybe the bracket of 90% can be removed too. |
| LG | Agree with the proposal. |
| Fraunhofer | We are fine with the proposal, keeping two target levels (i.e. X = 0.2 for target level 1 and 0.5 m for target level 2).If one accuracy target is to be defined, we support 0.5m for Horizontal accuracy based on the captured evaluation results.  |

### Update#1 after first round of comments

Based on the comments there is a majority of companies who want to have only one target positioning accuracy in IIOT. Most companies agree to X=0.5m horizontal accuracy if one value should be selected, with 2 companies proposing X=0.2. All commenting companies are OK with Y=1m.

there was also a comment on the fact that not all techniques may fullfill are targets. A note is added to reflect the comment. Finally, the brackts for 90% target of vertical accuracy are removed.

**Revised Feature lead proposal:**

* **In Rel-17 target positioning requirements for commercial use cases are defined as follows:**
	+ **Horizontal position accuracy (< 1 m) for 90% of UEs**
	+ **Vertical position accuracy (< 3 m) for 90% of UEs**
	+ **End-to-end latency for position estimation of UE (< 100 ms)**
	+ **Physical layer latency for position estimation of UE (< 10 ms)**
* **In Rel-17 target positioning requirements for IIoT use cases are defined as follows:**
	+ **Horizontal position accuracy (< 0.5 m) for 90% of UEs**
	+ **Vertical position accuracy (< 1 m) for 90% of UEs**
	+ **End-to-end latency for position estimation of UE (<100ms)**
	+ **Physical layer latency for position estimation of UE (<10ms)**
* **Note 1: Target positioning requirements may not necessarily be reached for all scenarios**
* **Note 2: All positioning techniques may not achieve the target positioning requirements over all scenarios**

Companies are encouraged to provide their views in the table below

|  |  |
| --- | --- |
| Company | Comment |
| vivo | We can compromise for the progress，the FL proposal is okay for us, and FFS needs to be removed |
| FL | FFS is removed. Thanks vivo for spotting this.  |
| CATT | Support the revised FL proposal. |
| Nokia/NSB | Sorry to keep repeating the same statement but we still do not understand why we are rewriting the SID which very clearly states 0.2 m as the target requirement for IIoT.  |
| CMCC | We have concerns on this proposal. Agree with Nokia that 0.2m should be kept as the target horizontal accuary. |
| ZTE | Suggest to have separate service levels to settle disputes ,* + **Service level 1: X=0.2 m; Y=0.2 m**
	+ **Service level 2: X=0.5 m; Y=1 m**

**Note 3: All positioning techniques may not achieve all service levels over all scenarios for IIoT use cases** |
| LG | We are sorry to have taken everyone’s time, however, we also prefer to consider a set of multiple requirements and we also agree 0.2m for horizontail accuracy as mentioned by Nokia and CMCC. And then, we prefer to modify Note 2 consdiering Note 3 (in ZTE’s view) to as below:* **Note 2: All positioning techniques may not achieve the target positioning requirements over all scenarios and all service levels for IIoT use cases.**
 |

## UE efficiency

### Summary and initial proposal

In [1], the UE power model for UE efficiency evaluation is discussed. A measurement period assumption for RRM is proposed and power components are listed. In [2], a power consumption model is proposed. [5] underlines that the study of UE power consumption is up to each company.

|  |  |
| --- | --- |
| source | proposal |
| [1] | ***Observation 5: The following parameters are suited for PRS RRM power evaluation***

|  |  |
| --- | --- |
| N: Number of TRPs for intra-frequency measurement & search | Synchronous case |
| FR1 | FR2 |
| N=8 | 200 | 320 |

***Observation 6: Power consumption in RRC\_CONNECTED state should consider C-DRX configuration.******Observation 7: Power consumption in RRC\_IDLE/INACTIVE state should consider the following power components**** ***Synchronization to SSB, and hold-time in micro-sleep to maintain time/frequency synchronicity for further Rx/Tx***
* ***Reception of paging DCI in 2 two consecutive slots (Assuming FR1 SSB/RMSI multiplexing pattern 1 with paging search space being SS#0)***
* ***Data/RS Rx/Tx in RRC\_IDLE/INACTIVE state***
* ***DCI Rx following data Tx in INACTIVE state***
 |
| [2] | ***Proposal 4:*** * ***The power consumption model below for PRS measurement should be considered.***

|  |
| --- |
| For frequency layer i, the power of PRS measurement is represented as:$$E\_{i}=P\_{PRS}\*N\_{PRS}+E\_{MG\\_switch}$$For Nf frequency layers, the total power is$$E\_{Nf}=\sum\_{i=0}^{Nf-1}E\_{i}$$where*-* $E\_{i}$ is total power over slots over which measurements are carried out in frequency layer i*-* $P\_{PRS}$ is the slot average power for PRS measurements in frequency layer i*-* $N\_{PRS}$ is the number of slot over which measurements are carried out*-* $E\_{MG\\_switch}$ is the power for measurement gap switching*-* $E\_{Nf}$ is total power for Nf frequency layers |

 |
| [5] | **Proposal 1:** The study of the UE power consumption should allow flexibility for each company to detail their methodology for evaluation. |

There are several proposals to define power consumption in more details. Given the fact that this is the last meeting in the SI, it will be however difficult to reflect further agreements regarding evaluation assumptions. It is thus proposed to decide whether to detail the assumption for power consumption evaluation further, or leave it to companies to detail their evaluation.

**Feature lead proposal: For the study of UE power consumption, the methodology is:**

**Option 1: use the following power consumption model:**

* **For frequency layer i, the power of PRS measurement is represented as:**

$$E\_{i}=P\_{PRS}\*N\_{PRS}+E\_{MG\\_switch}$$

* **For Nf frequency layers, the total power is**

$$E\_{Nf}=\sum\_{i=0}^{Nf-1}E\_{i}$$

**where**

***-*** $E\_{i}$ **is total power over slots over which measurements are carried out in frequency layer i**

***-*** $P\_{PRS}$ **is the slot average power for PRS measurements in frequency layer i**

***-*** $N\_{PRS}$ **is the number of slot over which measurements are carried out**

***-*** $E\_{MG\\_switch}$ **is the power for measurement gap switching**

***-*** $E\_{Nf}$ **is total power for Nf frequency layers**

**- For RRC connected, include C\_DRX configuration**

**- For RRC idle, the following components are considered:**

* **Synchronization to SSB, and hold-time in micro-sleep to maintain time/frequency synchronicity for further Rx/Tx**
* **Reception of paging DCI in 2 two consecutive slots (Assuming FR1 SSB/RMSI multiplexing pattern 1 with paging search space being SS#0)**
* **Data/RS Rx/Tx in RRC\_IDLE/INACTIVE state**
* **DCI Rx following data Tx in INACTIVE state**

**Option 2: up to each company**

Companies are encouraged to provide their views in the table below

|  |  |
| --- | --- |
| Company | Comment |
| Futurewei | Option 2 |
| Nokia/NSB | We already have the following from last meeting: Conclusion:For power consumption evaluation, it is up to each company to detail their methodology (including power model) for evaluation.We suggest no more discussion on this proposal in this meeting.  |
| OPPO | Just as Nokia mentioned, we did already reach a conclusion on the UE efficiency evaluation in RAN1#102e. Why do we discuss it again?  |
| ZTE | Option 2. |
| CATT | Option 2. |
| Huawei/HiSilicon | Option 2. |
| Lenovo, Motorola Mobility | Option 2 |
| vivo | Thank FL for considering our proposal, we put our model in there because it is helpful for understanding the evaluation results of power consumption. We can agree option 2. |
| LG | We are also on the same page with Nokia and OPPO. |

### Conclusion on UE efficiency

The issue is closed, with all companies commenting agreeing not to discuss further the issue.

## Network Efficiency

### Summary and initial proposal

In [2], it is proposed to provide the PRS configuration (PRS comb size, # of symbols, number of TRPs, periodicity, repetition factor, muting pattern, numerology and beam sweeping assumptions) to assess resource utilization. In [4], a model for the PRS and SRS resource utilization is proposed adding the PRS resources over resource sets, and TRPs for a given gNB. In [8] it is proposed to use the measurement gap length to periodicity ratio for PRS and the SRS utilization as the definition for resource utilization. In [9], it is proposed to leave it to companies to define the utilization. In [13],[14] it is also proposed to take the measurement gap configuration into account for PRS resource utilization.

|  |  |
| --- | --- |
| source | proposal |
| [2] | ***Observation 1:*** * ***It may not be appropriate to have MG configuration in the evaluation of PRS/SRS resource utilization as a metric of network efficiency considering it is a UE-Specific configuration and does not affect network scheduling.***

***Proposal 3:*** * ***For the*** ***network efficiency based on PRS,*** ***at least the comb size, number of symbols, TRP number, PRS periodicity, resource repetition factor, muting pattern, numerology and beam sweeping assumptions of PRS should be included in resource utilization.***
* ***For the*** ***network efficiency based on SRS,*** ***at least the comb size, number of symbols, UE number, SRS periodicity, numerology and beam sweeping assumptions of SRS should be included in resource utilization.***
 |
| [4] | ***Proposal 2: The PRS/SRS resource utilization can be defined according to the configuration parameters of PRS/SRS resource as shown in the section 2.2.1and 2.2.2.*** |
| [8] | *Proposal 3: The resource overhead for DL PRS resource reception is calculated as the length of measurement gap / the repetition period of measurement gap.**Proposal 4: The resource overhead for SRS resource positioning is calculated as the ratio of symbols used to transmit SRS resource for positioning.* |
| [9] | **Proposal 1**: It is left to individual companies to define the resource utilization for positioning.  |
| [13] | ***Proposal 5: With regards to PRS resource utilization, for PRS processing with MG, the overhead caused by the chosen MG configuration should be considered, e.g. for a given PRS configuration, define the PRS usage as the smallest supported MG length which contains all the PRS resources of an instance.***  |
| [14] | **Network efficiency is reported in the form of the total resource utilization for positioning, including RS signal configuration and MG configuration. Aligned Tx/Rx beams is assumed.**  |

The contributions submitted propose various way to define efficiency. As with other proposal in this AI, there are several proposals to define network efficiency in more details. Given the fact that this is the last meeting in the SI, it will be however difficult to reflect further agreements regarding evaluation assumptions. It is thus proposed to decide whether to detail the assumption for power consumption evaluation further, or leave it to companies to detail their evaluation. The following options are proposed:

**Feature lead summary: when reporting network efficiency:**

**Alt1:**

**For DL PRS efficiency:**

* **Option1a: comb size, number of symbols, TRP number, PRS periodicity, resource repetition factor, muting pattern, numerology and beam sweeping assumptions**
* **Option 2a: The resource overhead for DL PRS resource reception is calculated as the length of measurement gap / the repetition period of measurement gap.**
* **Option 3a: define the PRS usage as the smallest supported MG length which contains all the PRS resources of an instance.**
* **Option 4a: according to equation 1 below**

**For UL SRS efficiency:**

* **Option 1b: comb size, number of symbols, UE number, SRS periodicity, numerology and beam sweeping assumptions**
* **Option 2b:The resource overhead for SRS resource positioning is calculated as the ratio of symbols used to transmit SRS resource for positioning.**
* **Option 3b: according to equation 1 below**

**Alt2: : It is left to individual companies to define the resource utilization for positioning.**

**Equation 1:**

$$DL\\_PRS\\_RU\_{PRS resource set i} = DL\\_PRS\\_RU\_{PRS resource set i, time-domain}×DL\\_PRS\\_RU\_{PRS resource set i, frequency-domain}$$

$$DL\\_PRS\\_RU\_{PRS resource set i, time-domain}=\frac{ NumOfSymbols\_{PRS resource}}{Periodicity\_{PRS resource set i}×NumOfSymbols\_{Per millisecond}}×NumofPRSResources\_{PRS resource set i}×RepetitionFactor\_{PRS resource set i} $$

$$DL\\_PRS\\_RU\_{PRS resource set i, frequency-domain}=\frac{BandWidth\_{PRS resource set i}}{BandWidth\_{System}}×\frac{1}{CombSizeN\_{PRS resource set i}}$$

$$DL\\_PRS\\_RU\_{TRP j} = \sum\_{i=1}^{N}DL\\_PRS\\_RU\_{PRS resource set i}$$

$$DL\\_PRS\\_RU\_{gNB x} = \sum\_{j=1}^{M}DL\\_PRS\\_RU\_{TRP j}$$

**Equation 2:**

$$SRS\\_Pos\\_RU\_{SRS resource set i} = SRS\\_Pos\\_RU\_{SRS resource set i, time-domain}×SRS\\_Pos\\_RU\_{SRS resource set i, frequency-domain}$$

$$SRS\\_Pos\\_RU\_{SRS resource set i, time-domain}=\frac{ NumOfSymbols\_{SRS resource}}{Periodicity\_{SRS resource set i}×NumOfSymbols\_{Per millisecond}}×NumofSRSResources\_{SRS resource set i} $$

$$SRS\\_Pos\\_RU\_{SRS resource set i, frequency-domain}=\frac{BandWidth\_{SRS resource set i}}{BandWidth\_{System}}×\frac{1}{CombSizeN\_{SRS resource set i}}$$

$$SRS\\_Pos\\_RU\_{UE j} = \sum\_{i=1}^{N}SRS\\_Pos\\_RU\_{SRS resource set i}$$

$$SRS\\_Pos\\_RU\_{gNB x} = \sum\_{j=1}^{M}SRS\\_Pos\\_RU\_{UE j}$$

Companies are encouraged to provide their views in the table below

|  |  |
| --- | --- |
| Company | Comment |
| Futurewei | Alt 2 |
| Nokia/NSB | Alt 2 |
| ZTE | Alt 2 |
| CATT | Alt1: For DL PRS efficiency: Option 4a.For UL SRS efficiency: Option 3b. |
| Huawei/HiSilicon | Alt 2 |
| Lenovo, Motorola Mobility | Alt 2 |
| vivo | I think there are different understandings of network efficiency, one is defined from network perspective (such 1a, 4a), another from UE perspective (such as 2a). For the supporter of Alt2, I have some questions to ask. If Alt 2a is adopted, can we think network efficiency is zero for the scenario with periodic PRS if no MG is configured for a UE? Can we think network efficiency is different if the MGL is different for different UEs? It is confused for us if defining network efficiency from UE perspective.Similar to PRS, if the UE number is not considered for network efficiency, can we think the network efficiency is the same whether the number of UEs is 0 or 100?Agreement:PRS/SRS resource utilization is the metric used to evaluate network efficiency* FFS: what is included in resource utilization, e.g. PRS/SRS/MG configurations, beam sweeping assumptions

Based on the agreement in RAN1 102-e, PRS/SRS resource utilization is the network efficiency. I think the PRS resource utilization is constant for network if periodic PRS are transmitted regardless of whether UE measures PRS or not. And we prefer to discuss network efficiency from the network perspective. MG configuration is UE-Specific, from the network perspective, one UE conducting measurement or configured with MG does not prevent the gNB scheduling other UEs, thus MG configuration will only affect the UE efficiency but not network efficiency. So for DL PRS efficiency, we prefer to 1a or 4a.Similar to PRS, for SRS, option 1b is better for us. |
| LG | Prefer Alt2. |

### Conclusion on network efficiency

The issue is closed, with the following conclusion captured online:

|  |
| --- |
| Conclusion:When reporting network efficiency, the methodology is left up to each company and details should be provided. |

## Further modelling assumptions

### Clutter model

#### Summary and initial proposal

In [2] , it is propose to add an additional clutter parameter. In [5], it is observed that no further modification is required.

|  |  |
| --- | --- |
| source | proposal |
| [2] | ***Proposal 5:*** * ***The clutter parameter {60%, 6m, 2m} should be evaluated to identify the performance gap with NLOS conditions.***
 |
| [5] | **Observation 1:** There is no further need to modify the existing agreement on the high clutter density scenarios in TR38.857. |

Given the fact that the SI is now on its last meeting, there is no possibility for the SI to be impacted by a decision on the clutted model. It is thus proposed not to further discuss it.

**Feature lead proposal: do not discuss further the clutter model assumption for NR positioning enhancements.**

Companies are encouraged to provide their views in the table below

|  |  |
| --- | --- |
| Company | Comment |
| Futurewei | Agree with FL proposal |
| Nokia/NSB | Agree with FL/Futurewei |
| ZTE | Agree with FL’s proposal |
| CATT | Support FL proposal. |
| Huawei/HiSilicon | Support. |
| vivo | Support |
| LG | Support. |

#### Conclusion on clutter model

The issue is closed, as all companies commenting agree with the proposal not to discuss further the clutter model assumption for NR positioning enhancements.

### UE and gNB Rx/Tx

#### Summary and initial proposal

In [5], it is proposed to finalize the model with X and Y values as follow

|  |  |
| --- | --- |
| source | proposal |
| [6] | * + **Define the tentative timing error parameter X = 5 ns at the gNB side and Y = 10 ns at the UE side**
	+ **Send LS to RAN4 group and ask for feedback on the proposed tentative values for X and Y**
 |

Since this is the last meeting for this SI, it will be difficult to send an LS to RAN4 and get feedback in time for the conclusion of the meeting. Similarly, defining tentative parameters will not impact the simulation results since companies will not have the time to update results.

**Feature lead proposal: timing error parameter X at the gNB side and Y at the UE side are provided by companies when evaluating UE and gNB RxTx errors.**

Companies are encouraged to provide their views in the table below

|  |  |
| --- | --- |
| Company | Comment |
| Nokia/NSB | Support. |
| ZTE | Support. |
| CATT | Support FL proposal. |
| Huawei/HiSilicon | Support. |
| vivo | Support |
| LG | Support. |

#### Conclusion on gNB and UE Rx/Tx

timing error parameters X at the gNB side and Y at the UE side are provided by companies when evaluating UE and gNB RxTx errors. The issue is closed.

### Phase model for PRS and SRS stitching

#### Summary and initial proposal

In [13], further details are provided to take into account the RF impact on frequency domain stitching for PRS and SRS. It is proposed to model the phase error using a random phase offset for each additional PFL used in the PRS aggregation.

|  |  |
| --- | --- |
| source | Proposal |
| [13], | ***Proposal 2: At least of the purpose of modelling the effect of phase offset between two PFLs, consider a uniformly distributed phase offset being added in the 2nd PFL with respect to the 1st PFL.******Proposal 3: At least of the purpose of modelling the effect of channel spacing between two PFLs,*** * ***consider simulating a range of gaps starting from ~1 MHz, to even up to tenths of MHz. It is up to each company to provide the values of gaps being considered.***
* ***No need to have an agreed/common algorithm on how to process the scenarios of PFL aggregation with frequency-domain gaps; companies are encouraged to provide a description of the algorithm used.***

***Proposal 4: At least for the purpose of modelling the effect of time drifts between two PFLs, consider defining a phase slope parameter that controls the amount of phase ramp being added in the subcarriers of the 2nd PFL with respect to the 1st PFL.*** |

As there are no further meetings after RAN1#103 for the SI, it will not be possible for companies to submit new simulations. However, discussing what should be assumed in the error models for PRS and SRS stiching is useful in order to derive meaningful conclusions in the enhancements.

**Feature lead proposal: for SRS bandwidth stiching and PRS bandwidth stiching, when modelling the effect of phase offset between two PFLs, a uniformly distributed phase offset is applied the 2nd PFL with respect to the 1st PFL.**

* **Companies to provide how the phase offest is modeled in their evaluations.**

Companies are encouraged to provide their views in the table below

|  |  |
| --- | --- |
| Company | Comment |
| Futurewei | Agree with FL proposal |
| Nokia/NSB | Okay. |
| ZTE | Okay. |
| CATT | Support FL proposal.BTW: It looks like there are several typos in the proposal: stiching may be stitching, and offest may be offset. |
| Huawei/HiSilicon | We would like to note that that both zero-phase offset and uniformly distributed phase offset should be considered to model different RF architectures and to model intra-band and inter-band.In addition, we would like to clarify the understanding that each company can still report different values of the range of the uniform distribution. |
| vivo | Support |
| LG | Support. there are some typos that need to be corrected. |

#### Conclusion on phase model for PRS and SRS stitching

The discussion is concluded online with the following:

|  |
| --- |
| Conclusion:For SRS bandwidth stitching and PRS bandwidth stitching, when modelling the effect of phase offset between two PFLs (for 2CCs in the UL), a uniformly distributed phase offset is applied to the 2nd PFL (2nd CC in the UL) with respect to the 1st PFL (1st CC in the UL).* If phase offset modeled, companies to provide how the phase offset is modeled in their evaluations.
 |

### Hand blockage losses and transmit power reduction

#### Summary and initial proposal

In [5], the proposal is confirming an earlier conclusion to leave it to companies to detail their methodology regarding hand blockage and transmit power reduction.

|  |  |
| --- | --- |
| source | Proposal |
| [5] | **Proposal 2:** For hand blockage losses and/or transmit power reduction, it is up to each company to detail their methodology (including power model) for evaluation.  |

Since the proposal from the contribution is confirming an earlier agreement, it is the FL opinion that no further discussion is needed on this aspect.

Companies are encouraged to provide their views in the table below

|  |  |
| --- | --- |
| Company | Comment |
| Nokia/NSB | Agree with FL.  |
| CATT | Agree to FL’s opinion. |
| Huawei/HiSilicon | OK |
| vivo | Support |
| LG | Agree with FL. |

#### Conclusion on hand blockage losses and transmit power reduction

The issue is closed, as all companies commenting agree with the proposal to close the issue.

# Conclusion

The discussion for the following Issues is closed:

* UE Efficiency (2.3). The issue is closed, with all companies commenting agreeing not to discuss further the issue.
* Network efficiency (2.4). The issue is closed, with the following conclusion captured online:

|  |
| --- |
| Conclusion:When reporting network efficiency, the methodology is left up to each company and details should be provided. |

* Additional clutter models (issue 2.5.1). there is consensus not to discuss further the clutter model assumption for NR positioning enhancements.
* UE and gNB Rx/Tx error model (issue 2.5.2). The timing error parameter X at the gNB side and Y at the UE side are provided by companies when evaluating UE and gNB RxTx errors.
* Phase model used to evaluation PRS/SRS bandwidth stitching (issue 2.5.3). The discussion is concluded online with the following:

|  |
| --- |
| Conclusion:For SRS bandwidth stitching and PRS bandwidth stitching, when modelling the effect of phase offset between two PFLs (for 2CCs in the UL), a uniformly distributed phase offset is applied to the 2nd PFL (2nd CC in the UL) with respect to the 1st PFL (1st CC in the UL).* If phase offset modeled, companies to provide how the phase offset is modeled in their evaluations.
 |

* Hand blockage losses and transmit power reduction (issue 2.5.4): issue already treated and closed during previous meetings.

# References

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16. [Post111-e][625][POS] End-to-end latency analysis (Intel), RAN2 email discussion