**3GPP TSG RAN WG1 #113 R1-2306138**

**Incheon, Korea, May 22nd – May 26th, 2023**

**Source: Moderator (ZTE)**

**Title: Moderator summary for LS on 1-symbol PRS**

**Agenda item: 9.15**

**Document for: Discussion and Decision**

# Introduction

In RAN1#112 meeting TEI agenda, RAN1 made the following agreement for NR positioning. And then RAN1 sent an LS R1-2302201to RAN2 and RAN3 (also CC to RAN4).

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| **Agreement*** Introduce 1-symbol PRS with legacy comb sizes.
	+ UE expects the suitable expected RSTD windows provided by LMF such that peak ambiguity is addressed. Otherwise no measurement accuracy requirements are expected to be met.
	+ Not to define RAN4 RRM requirement, including core/performance in Rel-18
	+ Send an LS to RAN2 and RAN3 to ask necessary signalling enhancements
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After that, RAN2 sent an Reply LS R1-2304328 [1] as follows

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| During RAN2#121-bis-e meeting, RAN2 agreed the following on 1-symbol PRS:

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| **Agreements:**RAN2 will introduce 1-symbol PRS in line with the RAN1 agreement.Reply LS to RAN1 to ask if a PDC change is also needed.LPP CR is agreed in principle; other CRs to be seen next meeting, evolved from the CRs at this meeting.Restrictions to the search window can be considered next meeting in LPP.Capability to be aligned with RAN1 feature list. |

RAN2 would also like to ask the following question to RAN1:**Question**: Do we need changes to DL PRS configuration used for RTT-based Propagation Delay Compensation?  |

Meanwhile, in RAN1#112bis-e meeting, RAN1 agreed the corresponding UE feature groups in [R1-2304282](file:///C%3A%5CMyMeetings%5CTSGR1_112b-e%5CDocs%5CR1-2304282.zip) and RRC parameters in [R1-2304238](file:///C%3A%5CMyMeetings%5CTSGR1_112b-e%5CDocs%5CR1-2304238.zip) for PRS-based PDC.

This contribution is to summarize the proposals about the question from RAN2 LS based on the contributions [2-12], and collect the further views from companies.

## **Check points:**

Since we have online discussion Thursday for TEI comeback. Please provide your views **on Wednesday or before**.

# Discussion

## **2.1 The necessity of changes**

In [2][3][4][5][6][7][8][11][12], the necessity of the changes is confirmed, while [9][10] may not think the change for RRC is needed. Since RAN1 has made agreement on UE feature and RRC parameters for PRS-based PDC, it is straightforward to reply RAN2 that the changes to DL PRS configuration used for RTT-based Propagation Delay Compensation is needed. The following proposal is suggested.

***Proposal 2.1-1:*** *RAN1 replies RAN2 that changes to DL PRS configuration used for RTT-based Propagation Delay Compensation are needed.*

**Question:** Do you think the agreed RRC parameters and UE capability should be mentioned in the reply LS ?

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| **Company** | **Comments for the proposal and question** |
| Huawei, HiSilicon | OK |
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## **2.2 QCL source issue**

In [6], it mentions that there is no expected RSTD window provided to the UE for peak ambiguity purposes for the 1-symbol PRS PDC, so the following note is proposed in the *numSymbols* field description:

* The UE does not expect to be configured for PDC with a PRS with *numSymbols* equals to n1 unless an SSB index is provided as a Type-C or Type-C & Type-D QCL source, or another PRS resource with *numSymbols* more than 1 is provided as QCL source.

***Proposal 2.2-1:*** *For the 1-symbol PRS PDC, RAN1 proposes the following note to be added in the numSymbols field description:*

* *Note: The UE does not expect to be configured for PDC with a PRS with numSymbols equals to n1 unless an SSB index is provided as a Type-C or Type-C & Type-D QCL source, or another PRS resource with numSymbols more than 1 is provided as QCL source.*

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| **Company** | **Comments**   |
| Qualcomm | We support the above proposal. An unstaggered PRS needs to have a Type-C QCL source from an RS that can avoid any potential aliasing. It is an issue of robustness, and the assumption for any RS coming from a serving gNB. The only reason PRS could have lived without a QCL source is because it is fully staggered, but now we have a new feature specified and it should have a QCL source as any other signal (CSIRS, TRS, etc). |
| Huawei, HiSilicon | We do not support this restriction. Note that PDC RS timing is also following serving cell timing, it is not clear when UE is able to receive the timing provided by network (e.g. SIB9), why a PDC-PRS should have the timing ambiguity of 270ns (3.33us/12). |
| Qualcomm2 | To Huawei, HiSilicon: Because there can be far away multipaths, blockings, transparent reflectors, and repeaters in a deployment and there can be long time delays introduced because of that. When the UE follows the serving cell timing, it just means that the UE “locks” around the strongest path, but NOT around the earliest path. For PDC RS, yes, we still use the same synchronization as that for other communication channels. Since the “earliest path” and the “strongest path” can be very different, if there is aliasing, when these paths are away from each other (e.g. >270 nsec in the example shown above), the UE will report a wrong measurement.  |

## **2.3 RAN4 RRM issue**

In [7], an additional LS to RAN4 is suggested to inform RAN4 not to define RRM requirements for 1-symbol PRS in PDC. The reason is copied below.

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| The issue is that: there can be a conflict between the claimed benefits of 1-symbol PRS and the RAN4 RRM performance requirement applicability to the 1-symbol PRS. To be more specific, in current RAN4 specification TS 38.133 section 10.1.40 (specifically for PRS-based PDC), the UE Rx-Tx time difference measurement accuracy requirement tables list the accuracy requirements against a number of parameters, one of which is “PRS resource repetition” that is formulated as $T\_{rep}^{PRS}×L\_{PRS}/K\_{comb}^{PRS}$, where $T\_{rep}^{PRS}$ corresponds to the PRS repetition factor in time domain. RAN4 currently does not seem to consider this “PRS resource repetition” to be less than a constant, say $γ$ ($γ$ equals to either 1 or 4 in those RAN4 tables). In such a case, $T\_{rep}^{PRS}×\frac{L\_{PRS}}{K\_{comb}^{PRS}}\geq γ\geq 1$ leads to $T\_{rep}^{PRS}\geq γ∙K\_{comb}^{PRS}/L\_{PRS}$. When $L\_{PRS}=1$, $T\_{rep}^{PRS}\geq γ∙K\_{comb}^{PRS}\geq 2γ\geq 2$. That is to say, in order to fit the existing RAN4 performance requirement framework or to maintain a comparable “PRS resource repetition” against an existing <$L\_{PRS}, K\_{comb}^{PRS}$> pair for $L\_{PRS}\geq 2$, unless $γ\leq 0.5$ appears in 38.133 which is not the case for now, 1-symbol PRS pattern likely needs to be repeated in time domain, which unfortunately neutralizes the claimed benefits from using 1-symbol PRS, such as PRS overhead, PRS capacity and UE power saving. Therefore, if a common understanding is reached between RAN1 and RAN2 that 1-symbol PRS is applicable to PDC as well and this common understanding is also taken by RAN4, RAN1 should update with RAN4 that the RAN1 guidance in [4], such as “no RRM requirements”, is also applicable to the PDC case; otherwise, RAN4 may have to take extra efforts to work on new RRM requirements for PDC because the existing RAN4 RRM requirements may not be compatible to 1-symbol PRS unless 1-symbol PRS is required to be repeated.  |

Also, OPPO pointed out the LS R1-2302201 sent to RAN4 was for NR positioning only as follows. To make RAN4 have better understanding, Moderator thinks the proposal is reasonable.

LS R1-2302201:

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| In RAN1#112 meeting TEI agenda, RAN1 has made the following agreement **for NR positioning*** Introduce 1-symbol PRS with legacy comb sizes.
	+ UE expects the suitable expected RSTD windows provided by LMF such that peak ambiguity is addressed. Otherwise no measurement accuracy requirements are expected to be met.
	+ Not to define RAN4 RRM requirement, including core/performance in Rel-18
	+ Send an LS to RAN2 and RAN3 to ask necessary signalling enhancements
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***Proposal 2.3-1:*** *In case 1-symbol PRS is applicable to PDC, RAN1 informs RAN4 via LS not to define RRM requirements for 1-symbol PRS in PDC.*

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| **Company** | **Comments**   |
| Qualcomm | We agree to send an LS to RAN4, but we need to send the whole above reply. The first bullet is also very important for RAN4 to know.  |
| Huawei, HiSilicon | To avoid the repeated discussion on one WG asking another WG not to do something, we suggest to soften the tone as*In case 1-symbol PRS is applicable to PDC, RAN1 informs RAN4 via LS that RAN1 does not expect to define RRM requirements for 1-symbol PRS in PDC.*  |
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# Proposals

**Proposal:** With regard to 1-symbol PRS for RTT-based Propagation Delay Compensation,

* RAN1 replies RAN2 that changes to DL PRS configuration used for RTT-based Propagation Delay Compensation are needed. In addition, RAN1 proposes the following note to be added in the *numSymbols* field description:
	+ Note: The UE does not expect to be configured for PDC with a PRS with *numSymbols* equals to n1 unless an SSB index is provided as a Type-C or Type-C & Type-D QCL source, or another PRS resource with *numSymbols* more than 1 is provided as QCL source.
* RAN1 informs RAN4 via LS that RAN1 does not expect to define RRM requirements for 1-symbol PRS in PDC.

# Draft LS to RAN2 (CC to RAN4)

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| **1. Overall Description:**RAN1 would like to thank RAN2’s reply R2-2304510(R1-2304328) on 1-symbol PRS.With regard to RAN2’s question, RAN1 thinks the changes to DL PRS configuration used for RTT-based Propagation Delay Compensation are needed. In addition, RAN1 proposes the following note to be added in the *numSymbols* field description:* Note: The UE does not expect to be configured for PDC with a PRS with *numSymbols* equals to n1 unless an SSB index is provided as a Type-C or Type-C & Type-D QCL source, or another PRS resource with *numSymbols* more than 1 is provided as QCL source.

Furthermore, RAN1 does not expect to define RRM requirements for 1-symbol PRS in PDC.**2. Actions:****To RAN2** **ACTION:** RAN1 respectfully asks RAN2 to take the above information into account for their future work.   |

# Reference

1. R1-2304328 Reply LS on 1-symbol PRS RAN2, ZTE
2. R1-2304445 Draft reply LS on 1-symbol PRS vivo
3. R1-2304694 Discussion on 1-symbol PRS CATT
4. R1-2304695 Draft reply LS on 1-symbol PRS CATT
5. R1-2304926 Draft Reply LS to RAN2 on 1-symbol PRS ZTE
6. R1-2305317 Draft Reply to the LS on 1-symbol PRS Qualcomm Incorporated
7. R1-2305474 Discussion on RAN2 LS for using 1-symbol PRS in PDC OPPO
8. R1-2305582 [draft] Reply LS on 1-symbol PRS NTT DOCOMO, INC.
9. R1-2305825 Discussion on Reply LS on 1-symbol PRS Ericsson
10. R1-2305826 Draft LS reply on 1-symbol PRS Ericsson
11. R1-2305934 Discussion on 1-symbol PRS Huawei, HiSilicon
12. R1-2305860 TEI18: On 1-symbol PRS applicability to PDC Nokia, Nokia Shanghai Bell