**3GPP TSG RAN WG1 #100bis-e R1-20xxxxx**

e-Meeting, April 20th – 30th, 2020

Source: NTT DOCOMO, INC.

Title: Summary on Email discussion [100b-e-NR-UEFeatures-Positioning-02]

Agenda Item: 7.2.11.8

**Document for:** **Discussion and Decision**

# **Introduction**

This contribution summarizes the following email discussion in AI 7.2.11.8 regarding UE features for NR positioning.

[100b-e-NR-UEFeatures-Positioning-02] Email discussion/approval on the need of possible new FGs for NR positioning (20th-24th April) – Hiroki (DCM)

* Discuss whether or not to introduce following new FGs. If there is no consensus to add a new feature group at the end of this email discussion, the new feature group is not introduced in Rel-16.
	+ Support of the dedicated transmission of SRS for positioning
	+ Support of simultaneous processing of LTE PRS and NR PRS
	+ Support of simultaneous transmissions of SRS for positioning on a symbol
	+ Support of concurrent measurements (DL RSRP, DL RSTD, UE Rx-Tx Time Difference)
	+ Indication of concurrent configuration of list of measurements in supported CA Band Combination in the BandCombinationList

# **New feature group proposal**

# **New [13f-1]: Support of simultaneous processing of LTE PRS and NR PRS**

In [1], a tentative proposal was made as below.

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| --- |
| **Whether to define “Support of simultaneous processing of LTE PRS and NR PRS”?**Summary: One company assumes that it should be supported by default. Two companies are not in favour based on the reasons of different accuracy or lack of RSTD b/w E-UTRA and NR. Six companies are in favour.Proposal A:* Feature “Support of simultaneous processing of LTE PRS and NR PRS in different bands” is introduced
* Notes: Other DL PRS processing capabilities are not affected by introduction of this feature. If feature is not supported, it is up to UE implementation to select RAT for DL PRS processing
 |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |
| --- | --- | --- |
| [2] | ZTE | No. We don’t support to define such UE capability since we have agreed that RSTD measured between an E-UTRA cell and an NR cell is not supported in Rel-16. |
| [3] | vivo | Yes. (Support proposal A) |
| [4] | OPPO | No. |
| [5] | MediaTek Inc. | Yes. (Support proposal A) |
| [6] | LG Electronics | Not support to introduce the simultaneous processing of LTE PRS and NR PRS unless timing measurement reporting using concurrent measurements from LTE PRS and NR PRS is allowed. |
| [7] | Intel Corporation | Further discuss the need to define feature group “Support of simultaneous processing of LTE PRS and NR PRS in different bands” including the followins aspects* Impact on NR DL PRS processing capabilities when UE performs simultaneous LTE PRS processing
* How LMF will use this feature group if it is defined and mechanism for LMF to identify UE that indicated support of simultaneous LTE PRS and NR PRS processing on different bands
* Support of simultaneous NR DL PRS + NR DL PRS processing on different positioning frequency layers
 |
| [8] | CATT | Yes, if we assume the capability means UE can simultaneously process LTE PRS and NR PRS but independently, e.g., separate LTE RSTD and NR RSTD measurements, but not mixed LTE/NR measurements such as mixed LTE/NR RSTD. |
| [9] | Samsung | No. |
| [11] | Qualcomm Incorporated | Yes. We are supportive of this feature assuming it is within a common framework of concurrency of RAT-dependent methods which includes (LTE OTDOA, NR-TDOA, NR-AOD, NR-Multi-RTT). |
| [12] | Huawei, HiSilicon | Yes. Add the following UE capability under common NR DL PRS processing feature.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 13. Common NR DL PRS processing | 13-x | Concurrent LTE/NR PRS processing | Support of concurrent processing of LTE PRS and NR PRS | FFS 13-1 | Yes |  | Network does not know whether OTDOA and NR DL/RTT positioning can be used together. | 1) Per UE | No | No | NA |  | Optional with capability signalling{supported, notSupported} |

 |

## 2.1.1 Discussion 1

**Companies are encouraged to provide views on whether new FG for “Support of simultaneous processing of LTE PRS and NR PRS” is added or not.**

 **Adding the new FG supported by: Huawei, HiSilicon, Qualcomm (assuming it is concurrency of OTDOA & DL-TDOA), vivo, CATT**

 **Objected by:**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | If we do not define such a capability, LMF may request UE to perform OTDOA and DL-TDOA at the same time, and the requirements of both may not be fulfilled, and thus a priority between the TDOA and NR positioning should be defined or network should ensure that the measurement of only one of them is request. |
| Qualcomm | Overall, we support capability for concurrent positioning methods. For us this question is about concurrent request of OTDOA and DL-TDOA, and not about concurrent processing of LTE PRS and NR PRS. We are OK to support this capability, under the understanding that additional FG bits would be added for concurrent positioning methods, especially for NR TDOA + AoD and MRTT + AoD. |
| vivo | We support to add this new FG of “support of simultaneous processing of LTE PRS and NR PRS”. |
| CATT | Support to introduce the feature “support of simultaneous processing of LTE PRS and NR PRS in different bands”. |
| Nokia, NSB | We do not see the need for separate capability reporting for this feature as there is no assumption on coordination of LTE PRS and NR PRS from network side. If the feature is introduced then we need to also clarify what is the UE behavior in case the feature is not supported. |
| Intel  | Before we conclude we would like to understand companies views on the following aspects:* Impact on NR DL PRS processing capabilities when UE performs simultaneous LTE PRS processing
* How LMF will use this feature group if it is defined. How LMF will identify UE that indicated support of simultaneous LTE PRS and NR PRS processing on different bands.
* Support of simultaneous NR DL PRS + NR DL PRS processing on different positioning frequency layers
 |
| Samsung | Agree with Nokia and they might provide different level of accuracy. |

**FL proposal:**

* A new FG [13f-1] for support of simultaneous processing of LTE PRS and NR PRS is introduced.

# **New [13g-1]: Support of simultaneous transmissions of SRS for positioning on a symbol**

In [1], a tentative proposal was made as below.

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| --- |
| **Whether to define max number of simultaneous transmissions of SRS for positioning on a symbol?**Summary: Do not support - five companies. Support – four companies. Support for different CCs only – one company. Seems there is no concensus. Given that not many companies considered multi-CC scenario, it is suggested to conclude on the following proposal.Proposal B:* RAN1 to discuss and select one alternative:
	+ Alt.1. Feature “Simultaneous transmissions of SRS for positioning on a symbol” is not supported in R16, including transmission on different CCs
	+ Alt.2. Feature “Simultaneous transmissions of SRS for positioning on a symbol” is supported only for transmission of SRS for positioning on different CCs including intra-band and inter-band CA cases
 |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |
| --- | --- | --- |
| [2] | ZTE | Support Alt.1. Otherwise, power control among multiple resources should be clarified. |
| [3] | vivo | We support Alt.2. During RAN1#100e [100e-NR-Rel-16-UEFeatures] email discussion, several companies including us thought this is not need given the agreement made in [100e-NR-Pos-ULRS-01] where “the UE is not expected to transmit multiple SRS resources with different spatial relations in the same symbol”. However, we noticed that the discussion in [100e-NR-Pos-ULRS-01] is only for single carrier case. For intra-band and inter-band CA cases where transmission of SRS for positioning is on different CCs, we think this feature is beneficial. |
| [4] | OPPO | Support Alt.2. We shall define the maximum number of SRS resources across CCs for CA case. |
| [6] | LG Electronics | Support Alt.2. |
| [7] | Intel Corporation | Support Alt.2. |
| [8] | CATT | No strong opinion. SRS is transmitted in a single port. We don’t see the usage for UE to simultaneously transmit multiple SRS resources for positioning on the same symbol. |
| [9] | Samsung | Support Alt.2. |
| [12] | Huawei, HiSilicon | Support Alt.2. Add the following UE capability under SRS for positioning.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 13d. NR Multi-RTT13e. SRS for positioning | 13d-x13e-y | Simultaneous transmission | Max number of SRS resources for positioning on a symbol for intra-band CA | FFS | Yes |  | Network does not know whether it is allowed to configure SRS for positioning across CC for intra-band CA | 2) Per band | No | No | NA |  | Optional with capability signalling{1, 2} |

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## 2.2.1 Discussion 2

**Companies are encouraged to provide views on whether new FG for “Support of simultaneous transmissions of SRS for positioning on a symbol” is added or not.**

 **Adding the new FG supported by: Qualcomm (for intra-band & inter-band)**

 **Objected by:**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | This may be related to another email thread.[100b-e-NR-Pos-03] Email discussion/approval on the following issues by 4/23; if necessary, followed by endorsing the corresponding TPs by 4/28 – Florent (Ericsson)* UL SRS for positioning
	+ Simultaneous SRS transmission in a single symbol
	+ Intra-band collision between PosSRS and MimoSRS
	+ PHR for SRS positioning configuration
* UL RTOA reference time

Depending on the outcome, if such behaviour is allowed for single CC, or intra-band CA, or both, the capability should be added. |
| Qualcomm | Even though we are supportive of this additional FG, as pointed out by HW/HiSi, we may need to wait for the outcome of the 03 ED. |
| vivo | Same understanding as Huawei/HiSilicon and Qualcomm, need to wait for the outcome of [100b-e-NR-Pos-03]. |
| CATT | After the email thread [100b-e-NR-Pos-03] had the conclusion, we can further discuss whether introducing this new FG. |
| Nokia, NSB | Wait for conclusion of the corresponding discussion in NR Positioning maintenance. |
| Intel | Under discussion in ED#3. Let’s wait for outcome there. |

# **New [13h-1]: Support of concurrent measurements (DL RSRP, DL RSTD, UE Rx-Tx Time Difference) and [13h-2]: indication of concurrent configuration of list of measurements**

In [1], a tentative proposals was made as below.

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| --- |
| **Whether to define capability for support of concurrent measurements (DL RSRP, DL RSTD, UE Rx-Tx Time Difference)?**Summary: Do not support – four companies (two companies mentioned support of concurrent measurements by default). Support – five companies. One company supports concurrency per method not per measurement.It seems there is no concensus to define capability for concurrent measurements. Proposal D:* Companies are encouraged to bring technical arguments why it is necessary to define capability for concurrent measurements/methods and whether concurrent measurements can be assumed by default.
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|  |
| --- |
| **Whether to define indication of concurrent configuration of list of measurements in supported CA Band Combination in the BandCombinationList?**Summary: Do not support – five companies (two companies mentioned support of concurrent measurements by default). Support – two companies. Seems there is no consensus and there is a dependency on resolution of D)Proposal E:* Continue discussion (it has dependency on outcome of Proposal D)
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Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

**For proposal D**

|  |  |  |
| --- | --- | --- |
| [2] | ZTE | Yes. |
| [3] | vivo | As we expressed in the discussion of UE DL PRS processing for UE capability under email thread [100e-NR-Pos-DL-PRS-02], our understanding is that when a UE process DL PRS, concurrent measurements and consequently measurement report generation based on the same DL PRS should always be allowed. Thus, there’s no need to define concurrent measurements.We noticed that RAN2 specify UE capability signaling per positioning method. We think it’s natural to define UE capability signaling to indicate whether supporting a particular positioning method. Though we don’t see a big difference in terms of UE DL PRS processing capability whether a UE support one or multiple positioning methods. |
| [4] | OPPO | No. |
| [5] | MediaTek Inc. | Yes. The capability is per band. |
| [7] | Intel Corporation | Clarify the meaning for concurrency of supported measurements/methods to facilitate positioning techniques and decide on the need for additional signalling. |
| [8] | CATT | Yes. It is important to let the network know if UE has the capability to measure DL RSRP, DL RSTD, UE Rx-Tx Time Difference simultaneously. |
| [9] | Samsung | No. |
| [11] | Qualcomm Incorporated | Add a sub-feature within the OTDOA, AoD and Multi-RTT capabilities, for the UE to report concurrency of methods (NR OTDOA, NR AoD, NR Multi-RTT) per UE. |
| [12] | Huawei, HiSilicon | Our answer is No. However, we can discuss the capability of simultaneous positioning methods within DL-TDOA, DL-AoD, and Multi-RTT. |

**For proposal E**

|  |  |  |
| --- | --- | --- |
| [2] | ZTE | Yes. |
| [3] | vivo | No. As we expressed above toward Proposal D, there’s no need to define concurrent measurements. As a result, the concurrent configuration of list of measurements in supported CA Band Combination in the BandCombinationList is also not needed. We would be fine to define UE capability signaling to indicate whether supporting concurrent configuration of list of positioning methods. |
| [4] | OPPO | No. |
| [5] | MediaTek Inc. | No. An indication of capability supporting positioning method per band is sufficient. |
| [8] | CATT | Not in Rel-16. It may need further discussion on how to support NR positioning for CA case. |
| [9] | Samsung | No. |
| [11] | Qualcomm Incorporated | Add a sub-feature within the OTDOA, AoD and Multi-RTT capabilities, for a UE supporting concurrency of 2 or more methods, to report concurrency of methods (NR OTDOA, NR AoD, NR Multi-RTT) per supported CA Band Combination. |
| [12] | Huawei, HiSilicon | Our answer is No for now, as at least some clarification is needed. As we are discussing UE capability reported to LMF, and PRS does not have to be transmitted on any CC, we do not see the need to report such. |

## 2.3.1 Discussion 3

**Companies are encouraged to provide views on whether new FG for “Support of concurrent measurements (DL RSRP, DL RSTD, UE Rx-Tx Time Difference)” is added or not.**

 **Adding the new FG supported by: Qualcomm (assuming it is concurrency of DL-TDOA, AoD, Multi-RTT), CATT**

 **Objected by:**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | We do still do not think they are needed. It is our understanding that if UE supports e.g. DL-TDOA, UE should support DL RSTD and DL PRS-RSRP for the same PRS, making capability based on concurrent measurement less useful. Instead, we support concurrent positioning methods. |
| Qualcomm | We support capability for concurrent positioning methods. At a minimum there needs to be a capability bit for concurrency of DL-TDOA + AoD and a capability bit for concurrency of MRTT + AoD: If the UE is signals that it supports OTDOA/MRTT and AOD separately, it does not mean that it supports these concurrently since:* each one may have different beam management procedures from UE perspective (Rx beam sweeping procedures). For example, in AoD, a UE needs to derive only RSRP values using common Rx beam across PRS resources, whereas for OTDOA/MRTT a UE may need to perform Rx beam sweeping to identify the best TOA.
* may process in a different way PRS. The processing required for deriving TOA is not necessarily the same as RSRP: An RSRP can be easily derived using a small BW of a PRS resource (e.g. see CSI-RS for RRM, or SSB), whereas for a good TOA estimation, the processing BW is very important.
* Large number of RSRP reporting may not be needed for TDOA. A UE may budget the processing for deriving TOA and 1 RSRP for TDOA/MRTT, but for AoD, it may try to use part of the processing resources of TOA estimate to derive up to 8 RSRPs.

Overall, a UE, may be able to do TDOA with RSTD and 1 RSRP report, or AoD with 8 RSRP report, but it may not be able to do TDOA (RSTD + 1 TDOA-RSRP) and AoD (8 AoD-RSRP) concurrently due to the differences in beam management, processing requirements and processing flows.  |
| vivo | We don’t think a capability for concurrent measurements is needed. We prefer to define capability for concurrent positioning methods.Referring to the discussion in [100b-e-NR-UEFeatures-Positioning-01], we saw for example, DL PRS resource processing and measurement report capabilities are separate FGs for DL-TDOA and DL-AoD. Our understanding is that those capabilities are for a corresponding positioning method only. They cannot be assumed to be met at the same time for multiple positioning methods if a UE doesn’t support concurrent positioning methods.  |
| CATT | We support to define capability for concurrent measurements or methods. It is important to let the network know if UE has the capability to measure DL RSRP, DL RSTD, UE Rx-Tx Time Difference simultaneously.  |
| Nokia, NSB | We would prefer to avoid separate capability for concurrent measurements or methods. |
| Intel | We are not convinced that it is needed. More discussion is needed. We assume server can issue concurrent request for methods/measurements. |
| Samsung | We do not see the need to support |

**FL proposal:**

* A new FG for support of concurrent measurements (DL RSRP, DL RSTD, UE Rx-Tx Time Difference) is not introduced.

## 2.3.2 Discussion 4

**Companies are encouraged to provide views on whether or not to define indication of concurrent configuration of list of measurements in supported CA Band Combination in the BandCombinationList.**

 **Defining the indication supported by: Qualcomm**

 **Objected by:**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Based on QC’s t-doc, it seems that the proposed indication consists of up to 8 bit-strings, each representing a band combination for inter-band CA. Each bit-string has 3 bits, each representing a supported measurement (DL PRS-RSRP, DL RSTD, and UE Rx – Tx time difference) or a supported positioning method (DL-AoD, DL-TDOA, and multi-RTT).If our understanding is correct, we fail to see any necessity of introducing it, as it is a common assumption that UE will receive PRS frequency layers in a TDM manner, and also it is strange that the measurement capability/positioning method capability for a band will be different if the band is in different band combinations. |
| Qualcomm | The report is about concurrency of methods for a given configured band combination in the following sense (examples with 2 extremes): If a UE is configured with single CC operation for communication purposes, it may have available processing/buffering resources (when No measurement gaps are configured) to process all positioning methods. However, if the same UE is configured with a maximum CA configuration in a specific band combination, it may have reached its envelope of processing and cannot support processing of any positioning method. In the example above, in the first case, the UE had onl 1 band active and could do PRS processing, but in the 2nd case, it has the maximum of supported bands active (as configured in the BandCombinationList) and didn’t have any processing power left (when measurement gaps are not configured).If the above is not agreed, at a minimum a UE should be able to report, in a per band basis, that it only supports DL/DL+UL Positioning methods (or PRS processing) with MGs configured (that is, no PRS processing without MGs). |
| vivo | No to concurrent configuration of list of measurements.Regarding Qualcomm’s reasoning, seems it assumes the UE reported DL processing capability will indicate with and without measurement gap configured. However, we believe such assumption is not decided yet, it’s one of issues to be discussed in [100b-e-NR-Pos-01] UE DL PRS Processing Capability. So we think this discussion should wait for the outcome of [100b-e-NR-Pos-01] UE DL PRS Processing Capability.  |
| CATT | We don’t think it is necessary to define indication of concurrent configuration of list of measurements in supported CA Band Combination at this stage.  |
| Samsung | Do not see the need. |

**FL proposal:**

* A new indication of concurrent configuration of list of measurements in supported CA band combination is not introduced.

# **13e-1: Reception of DL PRS and transmission of SRS for positioning to facilitate NR Multi-RTT support**

In [1], additional question for FG13e-1 is captured as below.

* Whether to introduce dedicated transmission of SRS for positioning components for Multi-RTT(13e)?

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |
| --- | --- | --- |
| [3] | vivo | No. Our preference is to keep the same transmission of SRS for positioning UE capability components among 13d and 13e. |
| [4] | OPPO | No. The transmission of SRS for positioning shall be defined as a separate UE feature |
| [5] | MediaTek Inc. | No. |
| [6] | LG Electronics | In contrast with transmission of SRS for UL-TDOA technique, transmission of SRS for positioning for Multi-RTT needs to be associated with some DL PRS resources where they are used for UE RX-TX time difference measurements. For example, the UE RX beam to receive PRS resource and UE TX beam to transmit SRS resource for positioning need to be the same direction. In the current phase, it is unclear what the dedicated transmission of SRS is, so we would like to discuss it. |
| [7] | Intel Corporation | In our view, the feature group transmission of SRS for positioning is the same across UL-TDOA, UL-AoA and Multi-RTT. |
| [8] | CATT | No. |
| [11] | Qualcomm Incorporated | Yes. |
| [12] | Huawei, HiSilicon | Our answer is Yes.We think RAN2 is also discussing the SRS capability transfer to LMF. In our understanding, a lite version of SRS capability should be provided to LMF, e.g. support of SRS for positioning, and other SRS capabilities may be requested from gNB/AMF, which needs LS to RAN2/RAN3/CT1. In summary, a dedicated transmission of SRS for positioning components is needed at least to cover whether UE supports SRS for positioning. |

## 3.1 Discussion 5

**Companies are encouraged to provide views on whether new FG for “Support of the dedicated transmission of SRS for positioning” is added or not.**

 **Adding the new FG supported by: Huawei, HiSilicon, Qualcomm**

 **Objected by: vivo, CATT**

|  |  |
| --- | --- |
| Company | Comment |
| Huawe/HiSilicon | We think a lite version of SRS capability should be provided to the LMF by the UE (in LPP), since Multi-RTT can only use SRS for positioning, and it is important for the LMF know if UE supports SRS for positioning to enable RTT positioning. The detailed capability can be retrieved from AMF if CT1 supports the signaling. The SRS capability in RRC should not be copy-pasted to LPP for multi-RTT. |
| Qualcomm | We don’t really see the need of the “lite version” that HW/HiSi describes above, it looks simpler to just send it over as is, without trying to debate which rows should be added or not in this lite report.Independent of the “lite/complete” report discussion, we have a preference the UE to report one FG for SRS transmission for UL Positioning and another FG for SRS transmission for MRTT.  |
| vivo | We don’t see the motivation of introducing this FG. Why transmission of SRS for positioning should be different for UL-TDOA, UL-AoA and Multi-RTT? |
| CATT | No need to introduce new FG for “support of the dedicated transmission of SRS for positioning”. The FG for transmission of SRS for positioning should be the same across UL-TDOA, UL-AoA and Multi-RTT. |
| Nokia, NSB | RAN2 is discussing if SRS capabilities should be available at just gNB or also LMF. We think we may need to involve them before making a final decision on this item. |
| Intel | Postpone discussion for the reasons explained by CATT and Nokia. |

# **Conclusion**

**FL proposal:**

* A new FG [13f-1] for support of simultaneous processing of LTE PRS and NR PRS is introduced.

**FL proposal:**

* A new FG for support of concurrent measurements (DL RSRP, DL RSTD, UE Rx-Tx Time Difference) is not introduced.

**FL proposal:**

* A new indication of concurrent configuration of list of measurements in supported CA band combination is not introduced.

TBD

# **References**

[1] R1-2001484 RAN1 UE features list for Rel-16 NR after RAN1#100-E Moderator (AT&T, NTT DOCOMO, INC.)

[2] R1-2001605 NR positioning UE features ZTE

[3] R1-2001723 Discussion on UE features for Rel-16 NR positioning vivo

[4] R1-2001739 Discussion on UE features for NR Positioning OPPO

[5] R1-2001831 Views on Rel-16 UE features for NR positioning MediaTek Inc.

[6] R1-2001956 Discussion on UE features for NR positioning LG Electronics

[7] R1-2002022 Input to discussion on UE features for NR Positioning Intel Corporation

[8] R1-2002073 Discussion of UE features for NR positioning CATT

[9] R1-2002156 UE features for NR positioning Samsung

[10] R1-2002479 On UE features for NR Positioning Nokia, Nokia Shanghai Bell

[11] R1-2002569 Discussion on NR Positionign UE features Qualcomm Incorporated

[12] R1-2002712 Rel-16 UE features for NR positioning Huawei, HiSilicon

[13] R1-2002624 View on UE feature description for NR positioning Ericsson