**3GPP TSG RAN WG1 #106-e R1-2108203**

**e-Meeting, August 16th – 27th, 2021**

**Agenda item:** 7.2.11

**Source:** Moderator (NTT DOCOMO, INC.)

**Title:** Summary on Rel-16 NR UE features related discussion

**Document for:** Discussion and Decision

1. Introduction

This contribution summarizes the discussions and proposals in AI 7.2.11 regarding Rel-16 UE features for NR positioning and MR-DC/CA enhancement.

Based on the discussions summarized in Section 2, following is a part of the suggested email discussions/approvals for AI 7.2.11.

**FL proposal #1 of email discussion/approval:**

**[105-e-NR-UEFeature-Positioning-01] Email discussion/approval on UE features for NR positioning**

* **Adopt either one of the following alternatives for including PRS-only TP in FG13-7a, 13-9b and 13-10e**
	+ **Alt.1: Adding a Note to include PRS-only TP in the related FGs for the purpose of UE feature list (TR 38.822) maintenance**
	+ **Alt.2: Adding a second component to include PRS-only TP in the related FGs for the purpose of UE feature list (TR 38.822) maintenance**
* **Add the value 96 for component 1 in FG13-2b, FG13-3b, and FG13-4b to align with the TS 37.355**

Companies are encouraged to check above FL proposal #1 and to provide feedback if any in below.

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| Company | Comment |
| ZTE | We think the issues should be addressed. For the first issue, we slightly prefer Alt.1 for simplicity. For the second issue, we support to revise UE capability.  |
| Nokia, NSB | For the first issue (PRS-only) we think it is premature to have a discussion on UE capabilities this meeting. The topic is still being debated in RAN2, and if needed we can address it after the situation becomes clearer in that group. Another aspect regarding the issue itself is that in principle it is not clear if there is any RAN1 impact that would justify changes to RAN1 UE features, but perhaps that will become clear once the topic is resolved in RAN2. On the second issue (value 96) it is OK to discuss it this week, as we need to align the capabilities. By the way, in order to make an informed decision it would be useful to understand why the value 96 was added to 37.355 in the first place.  |
| OPPO | Support the discussion and we prefer Alt.1 |
| Qualcomm | OK to discuss both issues. For first issue, Alt.2 is really not needed. In principle, we should be OK with Alt. 1 .We also tend to agree with Nokia that RAN1 behaviors does not really change, but our understanding is that RAN2 will receive an LS with the updated spreadsheet and add the new notes in the description of those fields in 37.355.  |
| Moderator (NTT DOCOMO) | Thank you very much for the feedbacks!For the second issue, there is no objection to discuss it. For the first issue, there is one company suggesting that this issue should be discussed after the situation becomes clearer in RAN2.So, the moderator would like to ask further feedback on the first issue, e.g., necessity of RAN1 discussion now. |
| Ericsson | For the first bullet, the PRS-only TP discussion has not converged in RAN2, therefore we prefer to delay the discussion on the issue until RAN2 is finished with the discussion. For the second bullet, we are fine with the revision of component 1 with the added value. |
| CATT | Support to discuss the first issue and down-select from the two alternatives.BTW: The title of email discussion should be [106-e-NR-UEFeature-Positioning-01] instead of [105-e-NR-UEFeature-Positioning-01]. |

Based on the discussions summarized in Section 3, the moderator would like to check companies views on whether RAN1 can resume the discussion on following proposal before receiving the RAN4 LS response.

**FL proposal #2 of email discussion/approval:**

**[105-e-NR-UEFeature-MRDCCA-01] Email discussion/approval on UE features for MR-DC/CA enhancement**

* **For FG18-1/1a/1b, add following note and ask RAN2 to modify the descriptions in TS38.306 accordingly**
	+ **In case MCG and/or SCG have cells in different frequency ranges, this capability is applicable for power sharing only between those MCG and SCG cells with UL in FR1**

Companies are encouraged to check above proposal and to provide feedback if any in below.

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| Company | Comment |
| ZTE | We are ok to discuss this issue. |
| Nokia, NSB | We are ok to discuss the issue |
| OPPO | Support to discuss it.  |
| Moderator (NTT DOCOMO) | Thank you very much for the feedbacks!As companies are ok to discuss this issue before receiving the RAN4 LS response, this issue can also be FL proposal for email discussion/approval.Please provide further feedback if any. |
| Ericsson | OK to discuss this issue. |

1. Discussion on UE features for NR positioning
	1. UE features for PRS-only TP (FG13-7a, 13-9b, 13-10e) and UE PRS resource capabilities (FG13-2b, 13-3b, 13-4b)

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|  | 13-7a | Support of DL PRS from serving/neighbor cell as QCL source of a DL PRS | 1. Support of DL PRS from serving/neighbor cell as QCL source of a DL PRSNote: Refers to Type-D support for FR2 | 13-1 | *prs-FromServNeighCellAsQCL-r16* | *DL-PRS-QCL-ProcessingCapabilityPerBand-r16**LPP* | n/a | n/a | Need for location server to know if the feature is supported.DL PRSs are in the same band | Optional with capability signaling |
|  | 13-9b | OLPC for SRS for positioning based on PRS from the neighbouring cells | 1. OLPC for SRS for positioning based on PRS from the neighbouring cells in the same band | 13-9 | *LPP**olpc-SRS-PosBasedOnPRS-Neigh-r16**RRC**olpc-SRS-PosBasedOnPRS-Neigh-r16*  | *LPP**OLPC-SRS-Pos-r16**RRC**OLPC-SRS-Pos-r16* | n/a | n/a | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
|  | 13-10e | Spatial relation for SRS for positioning based on PRS from the neighbouring cell | 1. Spatial relation for SRS for positioning based on PRS from the neighbouring cell in the same band | 13-10b | *LPP**spatialRelation-SRS-PosBasedOnPRS-Neigh-r16* *RRC**spatialRelation-SRS-PosBasedOnPRS-Neigh-r16*  | *LPP**SpatialRelationsSRS-Pos-r16**RRC**SpatialRelationsSRS-Pos-r16* | n/a | n/a (FR2 only) | Need for location server to know if the feature is supported. | Optional with capability signaling |

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|  | 13-2b | DL PRS Resources for DL AoD on a band combination | 1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1-only.Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}Note this is reported for FR1 only BC.2. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}Note this is reported for FR2 only BC3. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation.Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}Note this is reported for BC containing FR1 and FR2 bands4. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation.Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}Note this is reported for BC containing FR1 and FR2 bands | 13-1 | *1 fr1-Only-r16**2 fr2-Only-r16**3 fr1-r16/ fr1-FR2Mix-r16**4 fr2-r16/ fr1-FR2Mix-r16* | *maxNrOfDL-PRS-ResourcesAcrossAllFL-TRP-ResourceSet-r16/**DL-PRS-ResourcesBandCombination-r16**LPP* | n/a | n/a | Need for location server to know if the feature is supported.the reported value is the total number across all bands in the corresponding BCNote: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
|  | 13-3b | DL PRS Resources for DL-TDOA on a band combination | 1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1-only.Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}Note this is reported for FR1 only BC.2. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}Note this is reported for FR2 only BC3. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation.Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}Note this is reported for BC containing FR1 and FR2 bands4. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation.Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}Note this is reported for BC containing FR1 and FR2 bands | 13-1 | *1 fr1-Only-r16**2 fr2-Only-r16**3 fr1-r16/ fr1-FR2Mix-r16**4 fr2-r16/ fr1-FR2Mix-r16* | *maxNrOfDL-PRS-ResourcesAcrossAllFL-TRP-ResourceSet-r16/**DL-PRS-ResourcesBandCombination-r16**LPP* | n/a | n/a | Need for location server to know if the feature is supported.the reported value is the total number across all bands in the corresponding BCNote: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
|  | 13-4b | DL PRS Resources for Multi-RTT on a band combination | 1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1-only.Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}Note this is reported for FR1 only BC.2. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}Note this is reported for FR2 only BC3. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation.Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}Note this is reported for BC containing FR1 and FR2 bands4. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation.Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}Note this is reported for BC containing FR1 and FR2 bands | 13-1 | *1 fr1-Only-r16**2 fr2-Only-r16**3 fr1-r16/ fr1-FR2Mix-r16**4 fr2-r16/ fr1-FR2Mix-r16* | *maxNrOfDL-PRS-ResourcesAcrossAllFL-TRP-ResourceSet-r16/**DL-PRS-ResourcesBandCombination-r16**LPP* | n/a | n/a | Need for location server to know if the feature is supported.the reported value is the total number across all bands in the corresponding BCNote: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |

Following proposal is made in a contribution.

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| [1] | IntroductionIn RAN2#114-e, the discussion on the support PRS-only TP in LPP was noted below, with the indication of PRS-only TP postponed to the next meeting [1].

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| [R2-2106465](file:///C%3A%5CUsers%5Cmtk16923%5CDocuments%5C3GPP%20Meetings%5C202105%20-%20RAN2_114-e%2C%20Online%5CExtracts%5CR2-2106465%20LPP.docx) Summary for LPP Corrections for Positioning Ericsson discussion Rel-16 NR\_pos-CoreProposal 2 RAN2 to discuss CR R2-2105054 and decide if PRS-only TP applicability explicitly needs to be clarified in LPP specification.Discussion:P2:Ericsson think we have already captured what the TP is in stage 2 and NRPPa, so this may not be needed.Qualcomm think the clarification for PRS-only TP is useful to have, but we should do it in the same way as LTE. The CR as written makes the PCI mandatory in the cell ID in the assistance data; it can be done with a simple flag. They also think the requirement on the UE to include the cell ID does not work since the UE does not routinely decode SIB1 for neighbour cells, and copying the CGI from the assistance data does not work to disambiguate the report.Nokia point out the fields are Need ON and so no UE behaviour may be needed. They understand that we have a definition of PRS-only TP in the definitions.Qualcomm clarify that the indication to the UE that the AD is for a PRS-only TP is useful. We have this flag in LTE and it would be similarly useful in NR.Huawei confirm that the definition is there in stage 2, but they think it is needed also from the stage 3 perspective. On Qualcomm’s comment about copying the CGI, they think this can be done since the CGI is used to differentiate cells. Qualcomm understand that there is no value in copying it from the assistance data and it would make sense to include the DL-PRS-Id or an index into the AD list. Huawei think the UE could obtain CGI from the SI of the reported cell.Intel understand that the intention of the CR is for the PRS-only TP, and the reporting of CGI is separate from this; the CGI appears also outside the timestamp IE. Their understanding is that the UE can report the CGI if available, otherwise PCI+ARFCN, and the UE implementation can determine what is available.Ericsson think an ASN.1 change can be avoided and the PRS-only TP is already clear from the options in the cell ID.* Email

[R2-2106584](file:///C%3A%5CUsers%5Cmtk16923%5CDocuments%5C3GPP%20Meetings%5C202105%20-%20RAN2_114-e%2C%20Online%5CExtracts%5CR2-2106584%20LPP.docx) [AT114-e][614][POS] Remaining issues on LPP (Ericsson) Ericsson discussion Rel-16 NR\_pos-CoreProposal 2 PRS-Only TP indication is postponed to next meeting to allow companies to check if the change is essential and if yes how to address it; (example either via changing Need code and field description or flag in LPP ASN.1 with new range of PRS IDs)[I.e. R2-2105054 is postponed]=> The above proposals are agreed |

During the discussion, it was clarified that RAN2 intended to introduce PRS-only TP, which was clearly defined in TS 38.305 [3] as below.

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| **Transmission Point (TP)**: A set of geographically co-located transmit antennas (e.g. antenna array (with one or more antenna elements)) for one cell, part of one cell or one DL-PRS-only TP. Transmission Points can include base station (ng-eNB or gNB) antennas, remote radio heads, a remote antenna of a base station, an antenna of a DL-PRS-only TP, etc. One cell can include one or multiple transmission points. For a homogeneous deployment, each transmission point may correspond to one cell.**PRS-only TP**: A TP which only transmits PRS signals and is not associated with a cell. |

DiscussionUE features for PRS-only TPGiven that PRS-only TP may exist in NR systems, the current UE capabilities may require additional change to accommodate it. The impacted FGs include [2]* FG13-7a (PRS-PRS QCL capability)
* FG13-9b (SRS open loop power control via PRS)
* FG13-10e (SRS spatial relation via PRS)

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|  | 13-7a | Support of DL PRS from serving/neighbor cell as QCL source of a DL PRS | 1. Support of DL PRS from serving/neighbor cell as QCL source of a DL PRSNote: Refers to Type-D support for FR2 | 13-1 | *prs-FromServNeighCellAsQCL-r16* | *DL-PRS-QCL-ProcessingCapabilityPerBand-r16**LPP* | n/a | n/a | Need for location server to know if the feature is supported.DL PRSs are in the same band | Optional with capability signaling |
|  | 13-9b | OLPC for SRS for positioning based on PRS from the neighbouring cells | 1. OLPC for SRS for positioning based on PRS from the neighbouring cells in the same band | 13-9 | *LPP**olpc-SRS-PosBasedOnPRS-Neigh-r16**RRC**olpc-SRS-PosBasedOnPRS-Neigh-r16*  | *LPP**OLPC-SRS-Pos-r16**RRC**OLPC-SRS-Pos-r16* | n/a | n/a | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
|  | 13-10e | Spatial relation for SRS for positioning based on PRS from the neighbouring cell | 1. Spatial relation for SRS for positioning based on PRS from the neighbouring cell in the same band | 13-10b | *LPP**spatialRelation-SRS-PosBasedOnPRS-Neigh-r16* *RRC**spatialRelation-SRS-PosBasedOnPRS-Neigh-r16*  | *LPP**SpatialRelationsSRS-Pos-r16**RRC**SpatialRelationsSRS-Pos-r16* | n/a | n/a (FR2 only) | Need for location server to know if the feature is supported. | Optional with capability signaling |

In our view, there is no such need to differentiate PRS from a non-serving cell and PRS from a PRS-only TP, since the measurement towards such type of PRS (not from the serving cell) should be the same for the UE.The corresponding change may take either one of the following two alternatives.* Alt.1 Adding a Note in the related FGs for the purpose of UE feature list (TR 38.822) maintenance.

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|  | 13-7a | Support of DL PRS from serving/neighbor cell as QCL source of a DL PRS | 1. Support of DL PRS from serving/neighbor cell as QCL source of a DL PRSNote: Refers to Type-D support for FR2Note: This also includes PRS from a PRS-only TP as QCL source. | 13-1 | *prs-FromServNeighCellAsQCL-r16* | *DL-PRS-QCL-ProcessingCapabilityPerBand-r16**LPP* | n/a | n/a | Need for location server to know if the feature is supported.DL PRSs are in the same band | Optional with capability signaling |
|  | 13-9b | OLPC for SRS for positioning based on PRS from the neighbouring cells | 1. OLPC for SRS for positioning based on PRS from the neighbouring cells in the same bandNote: This also includes OLPC for SRS for positioning based on PRS from a PRS-only TP. | 13-9 | *LPP**olpc-SRS-PosBasedOnPRS-Neigh-r16**RRC**olpc-SRS-PosBasedOnPRS-Neigh-r16*  | *LPP**OLPC-SRS-Pos-r16**RRC**OLPC-SRS-Pos-r16* | n/a | n/a | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
|  | 13-10e | Spatial relation for SRS for positioning based on PRS from the neighbouring cell | 1. Spatial relation for SRS for positioning based on PRS from the neighbouring cell in the same bandNote: This also includes spatial relation for SRS for positioning based on PRS from a PRS-only TP. | 13-10b | *LPP**spatialRelation-SRS-PosBasedOnPRS-Neigh-r16* *RRC**spatialRelation-SRS-PosBasedOnPRS-Neigh-r16*  | *LPP**SpatialRelationsSRS-Pos-r16**RRC**SpatialRelationsSRS-Pos-r16* | n/a | n/a (FR2 only) | Need for location server to know if the feature is supported. | Optional with capability signaling |

* Alt.2 Adding a second component in the related FGs for the purpose of UE feature list (TR 38.822) maintenance.

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|  | 13-7a | Support of DL PRS from serving/neighbor cell as QCL source of a DL PRS | 1. Support of DL PRS from serving/neighbor cell as QCL source of a DL PRS2. Support of DL PRS from a PRS-only TP as QCL source of a DL PRSNote: Refers to Type-D support for FR2 | 13-1 | *prs-FromServNeighCellAsQCL-r16* | *DL-PRS-QCL-ProcessingCapabilityPerBand-r16**LPP* | n/a | n/a | Need for location server to know if the feature is supported.DL PRSs are in the same band | Optional with capability signaling |
|  | 13-9b | OLPC for SRS for positioning based on PRS from the neighbouring cells | 1. OLPC for SRS for positioning based on PRS from the neighbouring cells in the same band2. OLPC for SRS for positioning based on PRS from a PRS-only TP in the same band | 13-9 | *LPP**olpc-SRS-PosBasedOnPRS-Neigh-r16**RRC**olpc-SRS-PosBasedOnPRS-Neigh-r16*  | *LPP**OLPC-SRS-Pos-r16**RRC**OLPC-SRS-Pos-r16* | n/a | n/a | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
|  | 13-10e | Spatial relation for SRS for positioning based on PRS from the neighbouring cell | 1. Spatial relation for SRS for positioning based on PRS from the neighbouring cell in the same band2. Spatial relation for SRS for positioning based on PRS from a PRS-only TP in the same band | 13-10b | *LPP**spatialRelation-SRS-PosBasedOnPRS-Neigh-r16* *RRC**spatialRelation-SRS-PosBasedOnPRS-Neigh-r16*  | *LPP**SpatialRelationsSRS-Pos-r16**RRC**SpatialRelationsSRS-Pos-r16* | n/a | n/a (FR2 only) | Need for location server to know if the feature is supported. | Optional with capability signaling |

We do not see a strong need to update the name for the FG, since the changes in the components should be sufficient.The Stage-3 change in LPP and RRC capturing the related change can be up to RAN2.UE PRS resource capabilityAnother problem is on the misalignment between TS 37.355 and the UE capability spreadsheet/TR 38.822 on the number of PRS resources that UE can processing for FR1 in a band combination involving both FR1 and FR2.The value range of the field *fr1-r16* in *maxNrOfDL-PRS-ResourcesAcrossAllFL-TRP-ResourceSet-r16* of TS 37.355 [4], includes the n96: DL-PRS-ResourcesBandCombination-r16 ::= SEQUENCE { bandList-r16 SEQUENCE (SIZE (1..maxSimultaneousBands-r16)) OF FreqBandIndicatorNR-r16, maxNrOfDL-PRS-ResourcesAcrossAllFL-TRP-ResourceSet-r16  CHOICE { fr1-Only-r16 ENUMERATED {n6, n24, n64, n128, n192, n256, n512, n1024, n2048}, fr2-Only-r16 ENUMERATED {n24, n64, n96, n128, n192, n256, n512, n1024, n2048}, fr1-FR2Mix-r16 SEQUENCE { fr1-r16 ENUMERATED {n6, n24, n64, n96, n128, n192, n256, n512, n1024, n2048}, fr2-r16 ENUMERATED {n24, n64, n96, n128, n192, n256, n512, n1024, n2048}, ... }, ... }, ...}However, the value n96 does not exist in TR 38.822. We do not think changing TS 37.355 is needed, and thus propose that the existing UE capability value be updated. The impacted FGs include [2]:

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 13-2b | DL PRS Resources for DL AoD on a band combination | 1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1-only.Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}Note this is reported for FR1 only BC.2. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}Note this is reported for FR2 only BC3. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation.Values = {6, 24, 64, 96, 128, 192, 256, 512, 1024, 2048}Note this is reported for BC containing FR1 and FR2 bands4. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation.Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}Note this is reported for BC containing FR1 and FR2 bands | 13-1 | *1 fr1-Only-r16**2 fr2-Only-r16**3 fr1-r16/ fr1-FR2Mix-r16**4 fr2-r16/ fr1-FR2Mix-r16* | *maxNrOfDL-PRS-ResourcesAcrossAllFL-TRP-ResourceSet-r16/**DL-PRS-ResourcesBandCombination-r16**LPP* | n/a | n/a | Need for location server to know if the feature is supported.the reported value is the total number across all bands in the corresponding BCNote: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
|  | 13-3b | DL PRS Resources for DL-TDOA on a band combination | 1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1-only.Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}Note this is reported for FR1 only BC.2. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}Note this is reported for FR2 only BC3. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation.Values = {6, 24, 64, 96, 128, 192, 256, 512, 1024, 2048}Note this is reported for BC containing FR1 and FR2 bands4. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation.Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}Note this is reported for BC containing FR1 and FR2 bands | 13-1 | *1 fr1-Only-r16**2 fr2-Only-r16**3 fr1-r16/ fr1-FR2Mix-r16**4 fr2-r16/ fr1-FR2Mix-r16* | *maxNrOfDL-PRS-ResourcesAcrossAllFL-TRP-ResourceSet-r16/**DL-PRS-ResourcesBandCombination-r16**LPP* | n/a | n/a | Need for location server to know if the feature is supported.the reported value is the total number across all bands in the corresponding BCNote: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
|  | 13-4b | DL PRS Resources for Multi-RTT on a band combination | 1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1-only.Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}Note this is reported for FR1 only BC.2. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}Note this is reported for FR2 only BC3. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation.Values = {6, 24, 64, 96, 128, 192, 256, 512, 1024, 2048}Note this is reported for BC containing FR1 and FR2 bands4. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation.Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}Note this is reported for BC containing FR1 and FR2 bands | 13-1 | *1 fr1-Only-r16**2 fr2-Only-r16**3 fr1-r16/ fr1-FR2Mix-r16**4 fr2-r16/ fr1-FR2Mix-r16* | *maxNrOfDL-PRS-ResourcesAcrossAllFL-TRP-ResourceSet-r16/**DL-PRS-ResourcesBandCombination-r16**LPP* | n/a | n/a | Need for location server to know if the feature is supported.the reported value is the total number across all bands in the corresponding BCNote: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |

ConclusionIn this contribution, we have the following observations and proposals to correct the UE feature for NR positioning.***Observation 1: PRS-only TP is supported by RAN2 specification.******Observation 2: No need to differentiate between PRS from a PRS-only TP and PRS from a non-serving cell.******Observation 3: No need to update the name of the FG.**** ***Proposal 1: Adopt either one of the following alternatives for including PRS-only TP in FG13-7a, FG13-9b, and FG13-10e.***
* ***Alt.1 Adding a Note to include PRS-only TP in the related FGs for the purpose of UE feature list (TR 38.822) maintenance.***
* ***Alt.2*** ***Adding a second component to include PRS-only TP in the related FGs for the purpose of UE feature list (TR 38.822) maintenance.***
* ***Proposal 2: Add the value 96 in FG13-2b, FG13-3b, and FG13-4b to align with the TS 37.355.***
 |

Based on the above, following proposal can be discussed in RAN1#106-e meeting.

### **Discussion point #1**

* **Adopt either one of the following alternatives for including PRS-only TP in FG13-7a, 13-9b and 13-10e**
	+ **Alt.1: Adding a Note to include PRS-only TP in the related FGs for the purpose of UE feature list (TR 38.822) maintenance**
	+ **Alt.2: Adding a second component to include PRS-only TP in the related FGs for the purpose of UE feature list (TR 38.822) maintenance**
* **Add the value 96 for component 1 in FG13-2b, FG13-3b, and FG13-4b to align with the TS 37.355**
1. Discussion on UE features for MR-DC/CA enhancement
	1. UE features for NR-DC power sharing (FG18-1, 18-1a, 18-1b)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 18. MR-DC/CA enhancement | 18-1 | Basic UL power sharing for DC | Semi-static power sharing mode1 between MCG and SCG cells of same FR for NR dual connectivity. |  | *intraFR-NR-DC-PwrSharingMode1-r16* | *CA-ParametersNRDC-v1610*  | n/a | n/a | Absence means intra-FR DC is not supported.  | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-1a | Semi-static UL power sharing mode 2 for DC | Semi-static power sharing mode 2 between MCG and SCG cells of same FR for NR dual connectivity. | 18-1 | *intraFR-NR-DC-PwrSharingMode2-r16* | *CA-ParametersNRDC-v1610*  | n/a | n/a | Semi-static power sharing mode 2 between MCG and SCG cells of same FR is applicable only for synchronous NR dual connectivity | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-1b | Dynamic UL power sharing for DC | Dynamic power sharing between MCG and SCG cells of same FR for NR dual connectivity.1) T\_offset | 18-1 | *intraFR-NR-DC-DynamicPwrSharing-r16,* | *CA-ParametersNRDC-v1610* | n/a | n/a | 1) {short, long} | Optional with capability signalling |

Following proposals are made in contributions.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | UE capabilities related to NR-DC power control are currently captured in 38.306 as shown below. While the RRC configuration of power sharing made can be differentiated for FR1 and FR2 (i.e., using *nrdc-PCmode-FR1* or *nrdc-PCmode-FR2*), similar differentiation of UE capability is not present in current specs.**Current capability definitions from 38.306 vg40**

| ***Definitions for parameters*** | Per | M | FDD-TDDDIFF | FR1-FR2DIFF |
| --- | --- | --- | --- | --- |
| ***intraFR-NR-DC-PwrSharingMode1-r16***Indicates whether the UE supports intra-FR NR DC with semi-static power sharing mode1 between MCG and SCG cells of same frequency range as defined in TS 38.213 [11]. If this field is absent, the UE does not support intra-FR NR DC.  | BC | No | No | No |
| ***intraFR-NR-DC-PwrSharingMode2-r16***Indicates whether the UE supports semi-static power sharing mode2 between MCG and SCG cells of same frequency range for synchronous intra-FR NR DC as defined in TS 38.213 [11]. The UE indicating the support of this also indicates the support of *intraFR-NR-DC-PwrSharingMode1-r16.* | BC | No | No | No |
| ***intraFR-NR-DC-DynamicPwrSharing-r16***Indicates the UE support of dynamic power sharing for intra-FR NR DC between MCG and SCG cells of same frequency range with long or short offset as specified in TS 38.213 [11]. The UE indicating the support of this also indicates the support of *intraFR-NR-DC-PwrSharingMode1-r16.* | BC | No | No | No |

Given current status with p-NR-FR2 decision by RAN4, the UE capability definitions should be modified such that UEs can at least indicate support for a particular power sharing mode for FR1 only (i.e., applicable only to cells with FR1 UL in MCG and SCG) without indicating it as supported for FR2.RAN1 discussed possible updates to UE capabilities in [105-e-NR-UEFeature-MRDCCA-01] thread in RAN1#105e but the discussion could not conclude as RAN1 was waiting for RAN4 input. It was also discussed whether RAN1 could let RAN2 handle the UE capability aspect. However, in our understanding, it was decided in RAN2#113b-e meeting to wait for RAN1 input on this topic including any changes to UE capabilities and so RAN1 should provide input to RAN2. Two possible alternatives to update the UE capabilities are shown below.One option (Option 1) is to enable FR1-FR2 differentiation for these capabilities so that if UE indicates ‘yes’ for a FR, the capability is applicable for power sharing between MCG and SCG cells with UL in that FR. This separates the capability for FR1 NR-DC reporting (as also achieved by Option 1) but additionally provides more forward compatibility if RAN4 continues discussion for p-NR-FR2 and p-UE-FR2 in Rel17. **Proposed modification (Option 1)**

| ***Definitions for parameters*** | Per | M | FDD-TDDDIFF | FR1-FR2DIFF |
| --- | --- | --- | --- | --- |
| ***intraFR-NR-DC-PwrSharingMode1-r16***Indicates whether the UE supports intra-FR NR DC with semi-static power sharing mode1 between MCG and SCG cells of same frequency range as defined in TS 38.213 [11]. If this field is absent, the UE does not support intra-FR NR DC. If UE indicates support for a frequency range, this capability is applicable for power sharing between MCG and SCG cells with UL in that frequency range | BC | No | No | ~~No~~ Yes |
| ***intraFR-NR-DC-PwrSharingMode2-r16***Indicates whether the UE supports semi-static power sharing mode2 between MCG and SCG cells of same frequency range for synchronous intra-FR NR DC as defined in TS 38.213 [11]. The UE indicating the support of this also indicates the support of *intraFR-NR-DC-PwrSharingMode1-r16.*If UE indicates support for a frequency range, this capability is applicable for power sharing between MCG and SCG cells with UL in that frequency range | BC | No | No | ~~No~~Yes |
| ***intraFR-NR-DC-DynamicPwrSharing-r16***Indicates the UE support of dynamic power sharing for intra-FR NR DC between MCG and SCG cells of same frequency range with long or short offset as specified in TS 38.213 [11]. The UE indicating the support of this also indicates the support of *intraFR-NR-DC-PwrSharingMode1-r16.*If UE indicates support for a frequency range, this capability is applicable for power sharing between MCG and SCG cells with UL in that frequency range | BC | No | No | ~~No~~Yes |

Another option (Option 2) is to clarify in capability definitions that they are only applicable for FR1. i.e. as shown below. This is suitable if it is assumed that the capabilities are not needed for FR2 even in a future release (e.g. Rel17)**Proposed modification (Option 2)**

| ***Definitions for parameters*** | Per | M | FDD-TDDDIFF | FR1-FR2DIFF |
| --- | --- | --- | --- | --- |
| ***intraFR-NR-DC-PwrSharingMode1-r16***Indicates whether the UE supports intra-FR NR DC with semi-static power sharing mode1 between MCG and SCG cells of ~~same~~ frequency range 1 as defined in TS 38.213 [11]. If this field is absent, the UE does not support intra-FR NR DC.  | BC | No | No | No |
| ***intraFR-NR-DC-PwrSharingMode2-r16***Indicates whether the UE supports semi-static power sharing mode2 between MCG and SCG cells of ~~same~~ frequency range 1 for synchronous intra-FR NR DC as defined in TS 38.213 [11]. The UE indicating the support of this also indicates the support of *intraFR-NR-DC-PwrSharingMode1-r16.* | BC | No | No | No |
| ***intraFR-NR-DC-DynamicPwrSharing-r16***Indicates the UE support of dynamic power sharing for intra-FR NR DC between MCG and SCG cells of ~~same~~ frequency range 1 with long or short offset as specified in TS 38.213 [11]. The UE indicating the support of this also indicates the support of *intraFR-NR-DC-PwrSharingMode1-r16.* | BC | No | No | No |

**Conclusion**In this document, we discuss UE capability signaling impact due to the RAN4 LS [1] on p-NR-FR2. Given current status that RAN4 does not introduce the parameter P-NR-FR2 in Rel-16, an update to NR-DC UL power sharing capabilities is needed so that UEs can at least indicate support for a particular power sharing mode for FR1 only (i.e., applicable only to cells with FR1 UL in MCG and SCG) without indicating it as supported for FR2.Considering that RAN2 is waiting for RAN1 input on this issue (per RAN2 discussion in RAN2#113b-e), we propose the following* Agree on one of Option 1 or Option 2 (shown in section 2) to update the NR-DC power sharing UE capabilities by potentially also taking into account any RAN4 inputs received during RAN1#106e.
* Send LS to RAN2 requesting corresponding updates to 38.306.
 |
| [3] | The status of the discussion from RAN1#105-e is as follows, as captured in the email discussion summary:**Updated FL proposal #1*** **For FG18-1/1a/1b. add following note and ask RAN2 to modify the descriptions in TS38.306 accordingly**
	+ **In case MCG and/or SCG have cells in different frequency ranges, this capability is applicable for power sharing only between those MCG and SCG cells with UL in FR1**

Though most companies seemed to be fine with the proposal above, a decision could not be reached in the meeting because RAN1 was waiting for a RAN4 LS that was on the imminence of being agreed. Unfortunately, RAN4 failed to send the LS in the end, though it is clear from the related RAN4 discussions that the pending issues are not directly impacting RAN1. In our understanding, this proposal above is very well aligned with the current understanding from RAN4, which is reflected in an earlier LS [1]. In [1] it is clear that RAN4 does not intend to introduce power sharing mechanisms for FR2 in Rel-16, and hence it is not reasonable for RAN1 to redefine the FGs such that UE could indicate power sharing support in FR2. This would cause ASN.1 impacts for a feature that cannot be supported in Rel-16 in any case. Hence, we propose the following:**Proposal: Confirm updated FL proposal#1 above, i.e.** * **For FG18-1/1a/1b. add following note and ask RAN2 to modify the descriptions in TS38.306 accordingly**
	+ **In case MCG and/or SCG have cells in different frequency ranges, this capability is applicable for power sharing only between those MCG and SCG cells with UL in FR1**
 |

At the RAN1#105-e meeting, this issue was discussed and RAN1 concluded to wait for RAN4 response [4]. Although RAN1/2 have not received RAN4 LS response on this issue yet, the situation may or may not be changed from that in the RAN1#105-e discussion thanks to above two contributions proposing to discuss this issue even before receiving RAN4 LS response. Therefore, the moderator would like to check companies views on whether RAN1 can resume the discussion on following proposal before receiving the RAN4 LS response. Note that the corresponding CR for RAN1 specification regarding this issue is also provided in AI 7.2.10 [5].

### **Discussion point #2**

* **For FG18-1/1a/1b, add following note and ask RAN2 to modify the descriptions in TS38.306 accordingly**
	+ **In case MCG and/or SCG have cells in different frequency ranges, this capability is applicable for power sharing only between those MCG and SCG cells with UL in FR1**

Reference

[1] R1-2106502 Discussion on positioning UE features Huawei, HiSilicon

[2] R1-2107997 Update to NR-DC Power sharing UE capabilities Ericsson

[3] R1-2108196 On Rel-16 UE Features Nokia, Nokia Shanghai Bell

[4] R1-2106158 Summary on [105-e-NR-UEFeature-MRDCCA-01] Moderator (NTT DOCOMO, INC.)

[5] R1-2108147 Removal of power sharing for FR2-FR2 dual connectivity from Rel-16 Nokia, Nokia Shanghai Bell

[6] 3GPP TR38.822 v16.0.0

[7] 3GPP TS38.306 v16.5.0