**3GPP TSG RAN WG1 #100bis-e R1-2002880**

e-Meeting, April 20th – 30th, 2020

Source: NTT DOCOMO, INC.

Title: Summary on Email discussion [100b-e-NR-UEFeatures-Positioning-03]

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-03] Email discussion/approval on issues with capability signaling impacts for NR positioning based on DL PRS (27th -29th April) – Hiroki (DCM)

* Discuss on component(s) of each FG that need to be reported and candidate values for the component(s)
* Discuss on reporting type of each FG
* Discuss on the need of xDD and/or FRx differentiation for each FG of per-UE type
* Note that discussed FGs in this email discussion are derived by outcome of high priority email discussions (e.g., FG13-3~8 in FL proposal 1)

In the email discussion [100b-e-NR-UEFeatures-Positioning-01], following agreements were made.

**Agreements:**

* Following FGs are included in UE features list for positioning.
* [NR E-CID DL SSB RRM measurements with LPP support for NR Positioning]
* [NR E-CID DL CSI-RS RRM measurements with LPP support for NR Positioning]
* Common DL PRS Processing Capability
* DL PRS Resources for DL AoD
* DL PRS Resources for DL-TDOA
* DL PRS Resources for Multi-RTT
* SRS Resources for Positioning
* [Support of SSB from neighbor cell as QCL source of a DL PRS]
	+ This does not imply UE is required to perform SSB measurement for Positioning purpose
* [Support of DL PRS from serving/neighbor cell as QCL source of a DL PRS]
* DL PRS Measurement Report for DL-AoD
* Inter-frequency measurements for [DL-AoD]
* [DL PRS RSTD/[RSRP] Measurement Report for DL-TDOA]
* Inter-frequency measurements for [DL-TDOA]
* Support of Aperiodic SRS Resources for positioning
* Support of Semi-persistent SRS Resources for positioning
* [Support of OLPC for SRS for positioning from neighbor cell]
* [Support of Spatial relation for SRS for positioning from serving cell]
* [Support of Spatial relation for SRS for positioning from neighbor cell]
* [UE Rx-Tx Measurement Report for Multi-RTT]
* Inter-frequency measurement for [Multi-RTT]

# **13-1: Common DL PRS Processing Capability**

Based on agreements and [1], FG13-1 can be defined as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****( 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 13. NR Positioning | 13-1 | Common DL PRS Processing Capability | 1. Maximum DL PRS bandwidth in MHz, supported by UE. Values = [20, 50, 100, 200, 400] in MHz
2. Duration of DL PRS symbol in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE. Values for T = [0.125, 0.25, 0.5, 1, 40, 80, 160, 320, 640, 1280] ms

Notes:* 1. UE is not expected to support DL PRS bandwidth that exceeds the reported DL PRS bandwidth value
	2. UE DL PRS processing capability is defined for a single positioning frequency layer
	3. UE DL PRS processing capability is agnostic to DL PRS comb factor configuration
	4. FFS if UE DL PRS processing capability is agnostic to the configured SCS settings of DL PRS
	5. FFS if reported values of T are the same across bands within a FR or across FRs
	6. FFS cases w/ and w/o configuration of measurement gap
1. Max number of positioning frequency layers supported by UE for DL PRS RSRP measurement report. Values = {1, [2, 3], 4}
 | TBD | [No] | N/A |  | [Per band] | [N/A] | [N/A] | [N/A] | Need for location server to know if the feature is supported. | Optional with capability signaling |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | 1. It is should be per-band as in the agreement.
2. Component-1: The bandwidth should be split for FR1 band and FR2 band with
	1. FR1 bands: 5, 10, 20, 40, 50, 80, 100
	2. FR2 bands: 50, 100, 200, 400
3. Component-2:
	1. T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms
	2. N: {0.125, 0.25, 0.5, 1, 2, 4, 8, 12, 16, 20, 25, 30, 35, 40, 45, 50} ms
4. Component-3: This should be not be added as it is not reported per band.
5. Additional components: Suggest to have number of DL PRS resources that UE can process in a slot under it
	1. FR1 bands: {1, 2, 4, 8, 16, 32, 64} for each SCS: 15kHz, 30kHz, 60kHz
	2. FR2 bands: {1, 2, 4, 8, 16, 32, 64} for each SCS: 15kHz, 30kHz, 60kHz
6. Reported per band
 |
| Qualcomm**Updated 04/29** | * Component 1: Related to ED-01. Update according to the agreements
* Component 2: Related to ED-01. Update according to the agreements
* Add new component according to the result of ED-01 (e.g. Number of PRS resources per slot)

Per Band reporting for the above* Component 3: Add the values 2,3 (remove the brackets), update the word as: “Max number of positioning frequency layers supported by UE”
	+ **Qualcom2: This component shall be reported per UE**
 |
| MTK**Updated 04/30** | 1. The signaling is per band
2. Support HW’s view on components 1 & 2.

We would like to clarify that if UE report (N, T) = (8, 160), it means UE can process N = 8ms PRS within T = 160ms. It also means that * UE can process N = 4ms PRS within T = 80ms
* UE can process N = 2ms PRS within T = 40ms
* … and so on.

Also, the signaling is agnostic to SCSIs above the common standing of the (N, T) signaling?1. For component 3, in our view, the wording should be “max number of positioning frequency layers supported by UE for DL PRS ~~RSRP~~ measurement ~~report~~. Values = {1, [2, 3], 4}”.
	1. **This component shall be reported per UE with FR differentiation**
 |
| ZTE | 1. Per band
2. Component 1-2 can be finalized acccording to ED1.
3. Component 3, agree with MTK and remove the bracket.
 |
| CATT | * Component 1: Share the similar view as HW to have difference sets of maximum BW for FR1 and FR2.
* Component 2: Related to ED-01. Update according to the agreements;
* Component 3: Share the similar view as QC, rewording it to “Max number of positioning frequency layers supported by UE”
* Support add new component according to the result of ED-01 (e.g. Number of PRS resources per slot) as suggested by HW and QC.

For the question from MTK, whether if UE report (N, T) = (8, 160), it implies the UE also supports (N, T) = (4, 80), (2,40), etc., which seems reasonable to us. In addition, we would like to ask whether we it is common understanding that if a UE reports the support of (8, 160), it means the UE is unable to support (8, T) if T<160. |
| vivo | * FG 13-1 is per band.
* Component 1: support to have difference sets of maximum BW for FR1 and FR2 as proposed by Huawei.
* Component 2: update according to the agreements in AI 7.2.8.1 ED#1;
* Component 3: support Qualcomm’s rewording of “Max number of positioning frequency layers supported by UE” and remove brackets for values of 2 and 3
* Support to add a new component according to the agreements in AI 7.2.8.1 ED#1 (i.e. Number of PRS resources per slot)
 |

# **13-2: DL PRS Resources for DL AoD**

Based on agreements and [1], FG13-2 can be defined as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****( 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 13. NR Positioning | 13-2 | DL PRS Resources for DL AoD | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE. Values = {1,2}
2. Max number of DL PRS Resources per DL PRS Resource Set

Values = [1, 4, 8, 16, 32, 64]1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets. Values = [64, 128, 192, 256, 512, 1024, 2048]
2. Max number of TRPs across all positioning frequency layers per UE. Values = [16, 32, 64, 128, 256]
3. Max number of DL PRS Resources per positioning frequency layer. Values = [32, 64, 128, 256, 512, 1024]
4. [Max number of DL PRS resources per TRP across all frequency layers. Value set: {4,8,16,32,64,128}]
 | TBD | No | N/A |  | [Per band] | [N/A] | [N/A] | [N/A] | Need for location server to know if the feature is supported. | Optional with capability signaling |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | 1. Per UE signaling with FR1/FR2 differentiation.
2. Component-1: {1,2}
3. Component-2: The minimum value is 2 for FR1, and 8 for FR2.
4. Component-3: The minimum value is 6 for FR1-only, and 24 for FR2-only, 6 for FR1 in FR1-FR2 mixed operation, 24 for FR2 in FR1-FR2 mixed operation.
5. Component-4: {3, 12, 64, 256}
6. Component-5: The minimum value is 6 for FR1-only, and 24 for FR2-only, 6 for FR1 in FR1-FR2 mixed operation, 24 for FR2 in FR1-FR2 mixed operation.
7. Component-6: Do not understand why we need this.
8. Suggest to have number of positioning frequency layers as a component here with {1,2,3,4}
 |
| Qualcomm | Support the above values (remove brackets)Per Band |
| MTK | 1. It is per band signaling
2. Component 6: do not understand why this is needed.
3. The number of positioning layer UE supports should be a component here. The value is {1,2,3,4}
 |
| ZTE | 1. Support above components
2. Per band
 |
| CATT | Component 1: SupportComponent 2: At least remove the value = 1. This FG is for DL AoD. Support of Max number of DL PRS Resources = 1 is not useful for DL AoD. Also, based component 5, the component 1, the minimum value for Component 2 is 32/2 =16. Component 3: SupportComponent 4: SupportComponent 5: SupportComponent 6: No strong view on whether to have this component. Share the same view as HW to add the number of positioning frequency layers as a component. |
| vivo | * FG 13-2 is per band.
* OK with Component 1 to 5 and values
* No strong view on component 6
* Regarding other companies’ comment to add the number of positioning frequency layers as a component under FG 13-2. We don’t think it is needed here given the number of positioning layers has already been captured as component 3 in FG 13-1 Common DL PRS Processing Capability.
 |

# **13-3: DL PRS Resources for DL-TDOA**

Based on agreements and [1], FG13-3 can be defined as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****( 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 13. NR Positioning | 13-3 | DL PRS Resources for DL-TDOA | 1. Max number of DL PRS Resource Sets per TRP per frequency layer. Values = {1, 2}
2. Max number of DL PRS Resources per DL PRS Resource Set. Values = [1, 4, 8, 16, 32, 64]
3. Max number of DL PRS Resources across all frequency layers, TRPs and DL PRS Resource Sets. Values = [64, 128, 192, 256, 512, 1024, 2048]
4. Max number of TRPs across all positioning frequency layers per UE. Values = [16, 32, 64, 96, 128, 256]
5. Max number of DL PRS Resources per positioning frequency layer. Values = [32, 64, 128, 256, 512, 1024]
6. [Max number of DL PRS resources per TRP across all frequency layers. Value set: {4,8,16,32,64,128}]
 | TBD | No | N/A |  | [Per band] | [N/A] | [N/A] | [N/A] | Need for location server to know if the feature is supported. | Optional with capability signaling |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | 1. Per UE signaling with FR1/FR2 differentiation.
2. Component-1: {1,2}
3. Component-2: The minimum value is 1 for FR1, and 1 for FR2.
4. Component-3: The minimum value is 3 for FR1-only, and 3 for FR2-only, 3 for FR1 in FR1-FR2 mixed operation, 3 for FR2 in FR1-FR2 mixed operation.
5. Component-4: {3, 12, 64, 256}
6. Component-5: The minimum value is 3 for FR1-only, and 3 for FR2-only, 3 for FR1 in FR1-FR2 mixed operation, 3 for FR2 in FR1-FR2 mixed operation.
7. Component-6: Do not understand why we need this.
8. Suggest to have number of positioning frequency layers as a component here with {1,2,3,4}
 |
| Qualcomm | Support the above values (remove brackets)Per Band |
| MTK | 1. It is per band signaling
2. Component 6: do not understand why this is needed.
3. The number of positioning layer UE supports should be a component here. The value is {1,2,3,4}
 |
| ZTE | 1. Support above componets
2. Per band
 |
| CATT | Component 1: SupportComponent 2: Based the proposed values for component 5 and the component 1, the minimum value for Component 2 is 32/2 =16. Component 3: SupportComponent 4: SupportComponent 5: SupportComponent 6: No strong view on whether to have this component. Share the same view as HW to add the number of positioning frequency layers as a component. |
| vivo | * FG 13-3 is per band.
* OK with Component 1 to 5 and values
* No strong view on component 6
* Regarding other companies’ comment to add the number of positioning frequency layers as a component under FG 13-3. We don’t think it is needed here given the number of positioning layers has already been captured as component 3 in FG 13-1 Common DL PRS Processing Capability.
 |

# **13-4: DL PRS Resources for Multi-RTT**

Based on agreements and [1], FG13-4 can be defined as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****( 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 13. NR Positioning | 13-4 | DL PRS Resources for Multi-RTT | 1. Max number of DL PRS Resource Sets per TRP per frequency layer. Values = {1, 2}
2. Max number of DL PRS Resources per DL PRS Resource Set. Values = [1, 4, 8, 16, 32, 64]
3. Max number of DL PRS Resources across all frequency layers, TRPs and DL PRS Resource Sets. Values = [64, 128, 192, 256, 512, 1024, 2048]
4. Max number of TRPs across all positioning frequency layers per UE. Values = [16, 32, 64, 96, 128, 256]
5. Max number of DL PRS Resources per positioning frequency layer. Values = [32, 64, 128, 256, 512, 1024]
6. [Max number of DL PRS resources per TRP across all frequency layers. Value set: {4,8,16,32,64,128}]
 | TBD | Yes | N/A |  | [Per band] | [N/A] | [N/A] | [N/A] | Need for location server to know if the feature is supported. | Optional with capability signaling |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | 1. Per UE signaling with FR1/FR2 differentiation.
2. Component-1: {1,2}
3. Component-2: The minimum value is 1 for FR1, and 1 for FR2.
4. Component-3: The minimum value is 3 for FR1-only, and 3 for FR2-only, 3 for FR1 in FR1-FR2 mixed operation, 3 for FR2 in FR1-FR2 mixed operation.
5. Component-4: {3, 12, 64, 256}
6. Component-5: The minimum value is 3 for FR1-only, and 3 for FR2-only, 3 for FR1 in FR1-FR2 mixed operation, 3 for FR2 in FR1-FR2 mixed operation.
7. Component-6: Do not understand why we need this.
8. Suggest to have number of positioning frequency layers as a component here with {1,2,3,4}
 |
| Qualcomm | Support the above values (remove brackets)Per Band |
| MTK | 1. It is per band signaling
2. Component 6: do not understand why this is needed.

The number of positioning layer UE supports should be a component here. The value is {1,2,3,4} |
| ZTE | 1. Support above componets
2. Per band
 |
| CATT | Component 1: SupportComponent 2: Based the proposed values for component 5 and the component 1, the minimum value for Component 2 is 32/2 =16. Component 3: SupportComponent 4: SupportComponent 5: SupportComponent 6: No strong view on whether to have this component. Share the same view as HW to add the number of positioning frequency layers as a component. |
| vivo | * FG 13-4 is per band.
* OK with Component 1 to 5 and values
* No strong view on component 6
* Regarding other companies’ comment to add the number of positioning frequency layers as a component under FG 13-4. We don’t think it is needed here given the number of positioning layers has already been captured as component 3 in FG 13-1 Common DL PRS Processing Capability.
 |

# **13-5: DL PRS Measurement Report for DL-AoD**

Based on agreements and [1], FG13-5 can be defined as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****( 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 13. NR Positioning | 13-5 | DL PRS Measurement Report for DL-AoD | 1. [Max number of DL PRS measurements on different PRS resources from the same TRP supported by the UE Values = {1, 2, 3, 4, 5, 6, 7, 8}]
 | TBD | No | N/A |  | [Per band] | [N/A] | [N/A] | [N/A] | Need for location server to know if the feature is supported. | Optional with capability signaling |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | 1. Per UE.
2. For the FR where the supported number of PRS resources within a resource set to be less than 8, the number of measurement that UE can measure and report is bounded by the supported number of PRS resources in a resource set.
 |
| Qualcomm | Support the above values (remove brackets)Per Band |
| MTK | Per band |
| ZTE | 1. Per band
2. Note : The report value cannot larger than max number of DL PRS resources per TRP .
 |
| CATT | Per band |
| vivo | FG 13-5 is Per band |

# **13-5a: Inter-frequency measurements for [DL-AoD]**

Based on agreements and [1], FG13-5a can be defined as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****( 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 13. NR Positioning | 13-5a | Inter-frequency measurement for [DL-AoD] | 1. Support of inter-frequency measurement for [DL-AoD]
 | TBD | No | N/A |  | [Per UE] | [No] | [No] | [N/A] |  | Optional with capability signalling{supported, notSupported} |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | 1. Per UE
 |
| Qualcomm | Support the above values (remove brackets)Per Band  |
| MTK | Per band combination |
| ZTE | Per band combination |
| CATT | Per UE or per FR. It may be too many combinations if per band combination. |
| vivo | FG 13-5a is per band combination. |

# **[13-6: DL PRS RSTD/[RSRP] Measurement Report for DL-TDOA]**

Based on [1], FG13-6 can be defined as below although it is under discussion in email discussion [100b-e-NR-UEFeature-Positioning-01].

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****( 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 13. NR Positioning | 13-6 | DL PRS RSTD/[RSRP] Measurement Report for DL-TDOA | 1. [Max number of DL PRS measurements on different PRS resources from the same TRP supported by the UE Values = {1, 2, 3, 4, 5, 6, 7, 8}]
 | TBD | No | N/A |  | [Per band] | [N/A] | [N/A] | [N/A] | Need for location server to know if the feature is supported. | Optional with capability signaling |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | 1. Per UE
2. {1,2,3,4}
3. For the FR where the supported number of PRS resources within a resource set to be less than 4, the number of measurement that UE can measure and report is bounded by the supported number of PRS resources in a resource set.
 |
| Qualcomm | Split into 2 FGs: * Max number of DL PRS RSTD per pair of TRPs supported by the UE. Values = {1, 2, 3, 4}
* Max number of DL PRS RSRP measurements on different PRS resources from the same TRP supported by the UE. Values = {1, 2, 3, 4}

Per band  |
| MTK | Agree with QC’s view |
| ZTE | Agree with QC |
| CATT | Agree with QC to split into 2 FGs. Our preference is per UE.  |
| vivo | Support Qualcomm’s proposal to split into 2 FGs with per band report for each.  |

# **13-6a: Inter-frequency measurements for [DL-TDOA]**

Based on agreements and [1], FG13-6a can be defined as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****( 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 13. NR Positioning | 13-6a | Inter-frequency measurement for [DL-TDOA] | 1. Support of inter-frequency measurement for [DL-TDOA]
 | TBD | No | N/A |  | [Per UE] | [No] | [No] | [N/A] |  | Optional with capability signalling{supported, notSupported} |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | 1. Per UE
 |
| Qualcomm | remove bracketsPer band  |
| MTK | Per band combination |
| ZTE | Per band combination |
| CATT | Per UE or per FR. It may be too many combinations if per band combination. |
| vivo | FG 13-6a is per band combination. |

# **[13-7:** **Support of SSB from neighbor cell as QCL source of a DL PRS]**

Based on [1], FG13-7 can be defined as below although it is under discussion in email discussion [100b-e-NR-UEFeature-Positioning-01].

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****( 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 13. NR Positioning | 13-7 | Support of SSB from neighbor cell as QCL source of a DL PRS | 1. Support of SSB from neighbor cell as QCL source of a DL PRS
 | TBD | No | N/A |  | [Per band] | [N/A] | [N/A] | [N/A] | Need for location server to know if the feature is supported. | Optional with capability signaling |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | 1. Per UE
2. We suggest to add another component considering that RAN4 already made the following agreement

Agreement: UE is not required to perform additional SSB measurement for the SSB configured as QCL source of PRS resources.* Support of reusing existing RRM measurement based on SSB from neighbor cells to facilitate PRS reception.
1. It means if UE does not support this FG, UE may simply ignore the QCL configuration, and if UE support this FG, UE will take advantage of the RRM measurement (timing, beam) to facilitate PRS reception as a best effort, e.g. in the early fix report.
 |
| Qualcomm | Add Note: Refers to Type-C for FR1 and Type-C & Type-D support for FR2Per band |
| MTK | Per band. |
| ZTE | Per UE |
| CATT | Per UE |
| vivo | FG 13-7 is per band. |

# **[13-7a:** **Support of DL PRS from serving/neighbor cell as QCL source of a DL PRS]**

Based on [1], FG13-7a can be defined as below although it is under discussion in email discussion [100b-e-NR-UEFeature-Positioning-01].

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****( 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 13. NR Positioning | 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 PRS
 | TBD | No | N/A |  | [Per band] | [N/A] | [N/A] | [N/A] | Need for location server to know if the feature is supported. | Optional with capability signaling |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | 1. Per UE
2. We do not know the consequence of this capability on UE and LMF side. Even the best effort UE reporting is not impacted on this capability.
 |
| Qualcomm | Add Note: Type-D support for FR2Per band |
| MTK | Per band |
| ZTE | Per UE |
| CATT | Per UE |
| vivo | Per band. |

# **Conclusion**

TBD

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****( 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 13. NR Positioning | 13-1 | Common DL PRS Processing Capability | 1. Maximum DL PRS bandwidth in MHz, supported by UE.

a) FR1 bands: {5, 10, 20, 40, 50, 80, 100}b) FR2 bands: {50, 100, 200, 400}1. Duration of DL PRS symbol in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE.

a) T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} msb) N: {0.125, 0.25, 0.5, 1, 2, 4, 8, 12, 16, 20, 25, 30, 35, 40, 45, 50} msNotes:* 1. UE is not expected to support DL PRS bandwidth that exceeds the reported DL PRS bandwidth value
	2. UE DL PRS processing capability is defined for a single positioning frequency layer
	3. UE DL PRS processing capability is agnostic to DL PRS comb factor configuration
	4. FFS if UE DL PRS processing capability is agnostic to the configured SCS settings of DL PRS
	5. FFS if reported values of T are the same across bands within a FR or across FRs
	6. FFS cases w/ and w/o configuration of measurement gap
1. [Max number of positioning frequency layers supported by UE for DL PRS measurement report. Values = {1, 2, 3, 4}]
2. Max number of DL PRS resources that UE can process in a slot under it
	1. FR1 bands: {1, 2, 4, 8, 16, 32, 64} for each SCS: 15kHz, 30kHz, 60kHz
	2. FR2 bands: {1, 2, 4, 8, 16, 32, 64} for each SCS: 15kHz, 30kHz, 60kHz
 | TBD | No | N/A |  | Per band[Per UE for component 3] | N/A | N/A[Yes for component 3] | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-2 | DL PRS Resources for DL AoD | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE.

Values = {1,2}1. Max number of DL PRS Resources per DL PRS Resource Set

Values = {[1], 4, 8, 16, 32, 64}1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets.

Values = {64, 128, 192, 256, 512, 1024, 2048} 1. Max number of TRPs across all positioning frequency layers per UE. Values = [{16, 32, 64, 128, 256} or {3, 12, 64, 256}]
2. Max number of DL PRS Resources per positioning frequency layer. Values = {32, 64, 128, 256, 512, 1024}
3. [Max number of DL PRS resources per TRP across all frequency layers. Value set: {4,8,16,32,64,128}]
4. [The number of positioning layer UE supports]

Values = {1, 2, 3, 4} | 13-3 (TBD) | No | N/A |  | FFS: [Per band or Per UE] | N/A | [N/A or Yes] | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-3 | DL PRS Resources for DL-TDOA | 1. Max number of DL PRS Resource Sets per TRP per frequency layer. Values = {1, 2}
2. Max number of DL PRS Resources per DL PRS Resource Set. Values = {1, 4, 8, 16, 32, 64}
3. Max number of DL PRS Resources across all frequency layers, TRPs and DL PRS Resource Sets. Values = {64, 128, 192, 256, 512, 1024, 2048}
4. Max number of TRPs across all positioning frequency layers per UE. Values = [{16, 32, 64, 96, 128, 256} or {3, 12, 64, 256}]
5. Max number of DL PRS Resources per positioning frequency layer. Values = {32, 64, 128, 256, 512, 1024]
6. [Max number of DL PRS resources per TRP across all frequency layers. Value set: {4,8,16,32,64,128}]
7. [The number of positioning layer UE supports]

Values = {1, 2, 3, 4} | 13-3 (TBD) | No | N/A |  | FFS: [Per band or Per UE] | N/A | [N/A or Yes] | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-4 | DL PRS Resources for Multi-RTT | 1. Max number of DL PRS Resource Sets per TRP per frequency layer. Values = {1, 2}
2. Max number of DL PRS Resources per DL PRS Resource Set. Values = {1, 4, 8, 16, 32, 64}
3. Max number of DL PRS Resources across all frequency layers, TRPs and DL PRS Resource Sets. Values = {64, 128, 192, 256, 512, 1024, 2048}
4. Max number of TRPs across all positioning frequency layers per UE. Values = [{16, 32, 64, 96, 128, 256} or {3, 12, 64, 256}]
5. Max number of DL PRS Resources per positioning frequency layer. Values = {32, 64, 128, 256, 512, 1024]
6. [Max number of DL PRS resources per TRP across all frequency layers. Value set: {4,8,16,32,64,128}]
7. [The number of positioning layer UE supports]

Values = {1, 2, 3, 4} | 13-3 (TBD) | Yes | N/A |  | FFS: [Per band or Per UE] | N/A | [N/A or Yes] | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-5 | DL PRS Measurement Report for DL-AoD | 1. Max number of DL PRS RSRP measurements on different PRS resources from the same TRP supported by the UE Values = {1, 2, 3, 4, 5, 6, 7, 8}
 | 13-3, 13-5 (TBD) | No | N/A |  | FFS: [Per band or Per UE] | [N/A] | [N/A] | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-5a | Inter-frequency measurement for DL-AoD | 1. Support of inter-frequency measurement for DL-AoD
 | TBD | No | N/A |  | FFS: [Per UE or per band or per BC] | [No or N/A] | [No or Yes or N/A] | N/A |  | Optional with capability signalling{supported, notSupported} |
| 13. NR Positioning | [13-6] | [DL PRS RSTD/[RSRP] Measurement Report for DL-TDOA] | 1. [Max number of DL PRS measurements on different PRS resources from the same TRP supported by the UE Values = {1, 2, 3, 4, 5, 6, 7, 8}]
 | TBD | No | N/A |  | [Per band] | [N/A] | [N/A] | [N/A] | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-6a | Inter-frequency measurement for DL-TDOA | 1. Support of inter-frequency measurement for DL-TDOA
 | TBD | No | N/A |  | FFS: [Per UE or per band or per BC] | [No or N/A] | [No or Yes or N/A] | N/A |  | Optional with capability signalling{supported, notSupported} |
| 13. NR Positioning | [13-7] | [Support of SSB from neighbor cell as QCL source of a DL PRS] | 1. [Support of SSB from neighbor cell as QCL source of a DL PRS]
 | TBD | No | N/A |  | [Per band] | [N/A] | [N/A] | [N/A] | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | [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 PRS]
 | TBD | No | N/A |  | [Per band] | [N/A] | [N/A] | [N/A] | Need for location server to know if the feature is supported. | Optional with capability signaling |

Comments

|  |  |
| --- | --- |
| Qualcomm | **13-1 Component 1:*** According to the agreement this meeting, the DL PRS processing is defined under these assumptions:

UE capability for DL PRS processing is defined assuming the case **with configured measurement gap and a maximum ratio of measurement gap length (MGL) / measurement gap repetition period (MGRP) of no more than X% (FFS: X)****Proposal 1:**Component 1 should be written as:Duration of DL PRS symbol in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz **and** **configured measurement gap and a maximum ratio of measurement gap length (MGL) / measurement gap repetition period (MGRP) of no more than X% (FFS: X)**, which is supported and reported by UE. **13-1 Component 3:**For component 3, this is not needed in the name. This is about “DL PRS processing” not about “DL PRS measurement report”. **Proposal 2:**[Max number of positioning frequency layers supported by UE ~~for DL PRS measurement report~~. Values = {1, 2, 3, 4}]**13-1 Component 4:*** For Component 4, the SCS need to be 60 Khz and 120 Khz because this is FR2. Also, similar comment as above on the assumptions

**Proposal 3:**Component 4 should be written as:Max number of DL PRS resources that UE can process in a slot ~~under it~~ assuming maximum DL PRS bandwidth in MHz **and** **configured measurement gap and a maximum ratio of measurement gap length (MGL) / measurement gap repetition period (MGRP) of no more than X% (FFS: X)**,* + FR1 bands: {1, 2, 4, 8, 16, 32, 64} for each SCS: 15kHz, 30kHz, 60kHz
	+ FR2 bands: {1, 2, 4, 8, 16, 32, 64} for each SCS: ~~15kHz, 30kHz,~~ 60kHz, 120 KHz

**[13-6]:*** There is clear support from the companies replied in the ED (QC, MTK, ZTE, CATT, vivo) of splitting this FG into 2:

Split into 2 FGs: * Max number of DL PRS RSTD per pair of TRPs supported by the UE. Values = {1, 2, 3, 4}
* Max number of DL PRS RSRP measurements on different PRS resources from the same TRP supported by the UE. Values = {1, 2, 3, 4}

**Proposal 4:** Split 13-6 to 2 BGs and put the both in brackets to inform RAN2 that further discussion is needed. Our technical concerns have not been addressed, and we didn’t have a chance to discuss those in a conference calls. For such cases, we prefer to put in brackets both rows, and continue the discussion in the next meeting.* + [DL PRS RSTD Measurement Report for DL-TDOA]
		- [Component 1: Max number of DL PRS RSTD per pair of TRPs supported by the UE. Values = {1, 2, 3, 4}]
	+ [DL PRS RSRP Measurement Report for DL-TDOA]\
		- [omponent 1: Max number of DL PRS RSRP measurements on different PRS resources from the same TRP supported by the UE. Values = {1, 2, 3, 4}]
 |
| MTK | 1. For FG 13-1:
* For component 3, the wording should be “Max number of positioning frequency layers supported by UE for DL PRS measurement ~~report~~. Values = {1, 2, 3, 4}”.

As comment before, this component should be signaled per UE with FR differentiation.* For component 4, FR2 part, it should be “FR2 bands: {1, 2, 4, 8, 16, 32, 64} for each SCS: ~~15kHz, 30kHz~~, 60kHz, 120 KHz”
1. For FG 13-2, 13-3, 13-4, we update our views as follows:
* The FG should be per UE with FR differentiation (since PRS processing capability is signaled per band)
* For component 4, value is {16, 32, 64, 128, 256}
* Component 6 is not needed
* Component 7 is not needed (since it is signaled per UE per FR in FG13-1 component 3)
1. For FG 13-5, don’t understand why 13-3 is the prerequisite feature group.

The prerequisite feature group should be FG13-2.The signalling should be per UE with FR differentiation (if FG13-2 is also per UE with FR differentiation)1. For 13-5a and 13-6a, the signalling is per band combination.
 |
|  |  |
|  |  |

# **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

[14] R1-2002878 Summary on Email discussion [100b-e-NR-UEFeatures-Positioning-01] Moderator (NTT DOCOMO, INC.)