**3GPP TSG RAN WG1 #100bis-e R1-2002881**

e-Meeting, April 20th – 30th, 2020

Source: NTT DOCOMO, INC.

Title: Summary on Email discussion [100b-e-NR-UEFeatures-Positioning-04]

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-04] Email discussion/approval on issues with capability signaling impacts for NR positioning based on SRS (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., FG13-9~11 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]~~
* OLPC based on PRS from the serving cell
* OLPC based on SSB from neighbouring cells
* OLPC based on PRS from the neighbouring cells
* Spatial relation for SRS for positioning based on SSB from the serving cell
* Spatial relation for SRS for positioning based on CSI-RS from the serving cell
* Spatial relation for SRS for positioning based on SRS
* Spatial relation based on PRS from the serving cell
* Spatial relation based on SSB from the neighbouring cell
* Spatial relation based on PRS from the neighbouring cell
* [UE Rx-Tx Measurement Report for Multi-RTT]
* Inter-frequency measurement for [Multi-RTT]

**Agreements:**

* [Support of OLPC for SRS for positioning from neighbor cell], [Support of Spatial relation for SRS for positioning from serving cell] and [Support of Spatial relation for SRS for positioning from neighbor cell] in agreements are updated to below.
  + OLPC based on PRS from the serving cell
  + OLPC based on SSB from neighbouring cells
  + OLPC based on PRS from the neighbouring cells
  + ~~Spatial relation based on SSB/CSI-RS/SRS from the serving cell~~
  + Spatial relation for SRS for positioning based on SSB from the serving cell
  + Spatial relation for SRS for positioning based on CSI-RS from the serving cell
  + Spatial relation for SRS for positioning based on SRS
  + Spatial relation based on PRS from the serving cell
  + Spatial relation based on SSB from the neighbouring cell
  + Spatial relation based on PRS from the neighbouring cell

**Agreements:**

* Adding following FGs
  + [OLPC for SRS for positioning based on SSB from serving cell]
  + OLPC for SRS for positioning based on CSI-RS from serving cell

**Agreements:**

* “Spatial relation based on SSB/CSI-RS/SRS from the serving cell” in agreements is updated to below.
  + Spatial relation for SRS for positioning based on SSB from the serving cell
  + Spatial relation for SRS for positioning based on CSI-RS from the serving cell
  + Spatial relation for SRS for positioning based on SRS

**Agreements:**

* Add a FG for “[PathLoss estimate maintenance]”
  + Component(s) include at least “Max number of monitored pathloss for SRS for positioning [across all cells]”
* Add a FG for “[Spatial relation maintenance]”
  + Component(s) include at least “Max number of [maintained] spatial relations for SRS for positioning [across all cells]”

# **13-8: SRS Resources for Positioning**

Based on agreements and [1], FG13-8 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 | 13-8 | SRS Resources for Positioning | 1. Max number of SRS Resource Sets for positioning supported by UE per BWP. Values = {1, 16}. Other values FFS 2. Max number of periodic SRS Resources for positioning supported by UE across all SRS Resource Sets per BWP. Values = {64}, Other values FFS. | 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. Suggest to split the FG into two FGs.    1. First FG is max number of SRS resource sets for positioning per BWP that is reported per band    2. Second FG is the max number of SRS resources for positioning per BWP that is reported per FS   Else, we suggest per FS all this FG.   1. Component-1: {1, 4, 16} 2. Component-2: Minimum value is 1 for FR1 band in a BC and 4 for a FR2 band in a BC. 3. Suggest to add another component:    1. Max number of SRS resources for positioning transmitted in a slot of a BWP       1. Note this includes total number of periodic SRS resources, activated semi-persistent SRS resources, and triggered aperiodic SRS resources in a slot.       2. Reported by FS       3. Minimum value is 1 for FR1 band in a BC and 1 for a FR2 band in a BC. |
| Qualcomm | Component 1: Add also values 2,4,8  Component 2: change to be about all P/SP/AP SRS resources for positioning. That is:   * Max number of P/SP/AP SRS Resources for positioning per BWP. Values = {1,2,4,8,16,32,64}   Add Component 3:   * Max number of P/SP/AP SRS Resources including the SRS resources for positioning per BWP per slot. Values = {1,2,3,4,5,6,8,10,12,14}   Add component 4:   * Max number of periodic SRS Resources for positioning per BWP. Values = {1,2,4,8,16,32,64}   Add component 5:   * Max number of periodic SRS Resources for positioning per BWP per slot. Values = {1,2,3,4,5,6,8,10,12,14}   Per FS |
| vivo | * FG 13-8 is per FS * Component 1: support to add values: 4 and 8 * Component 2: support Qualcomm’s view to be all SRS for positioning in general, not just periodic SRS. Max number of SRS Resources for positioning supported by UE across all SRS Resource Sets per BWP * To move original component 2 to component 3: Max number of periodic SRS Resources for positioning supported by UE across all SRS Resource Sets per BWP |
| CATT | * Per FS * Component 1: Support {1, 2, 4, 8, 16} with 2, 4 and 8 are added. * Component 2: Support {1, 2, 4, 8, 16, 32, 64}with 1,2,4,8,16,32 are added. * We share the same views with Qualcomm that a new Component 3 can be added for Max number of SRS Resources for positioning(including P/AP/SP SRS) supported by UE across all SRS Resource Sets per BWP with the values {1, 2, 4, 8, 16, 32, 64}. |
| ZTE | 1. Per FS 2. Component 1:Values = {1, 4, 8, 12, 16} 3. Component 2:Values = {1, 4, 8, 16, 32, 64} |

# **13-8a: Support of Aperiodic SRS Resources for positioning**

Based on agreements and [1], FG13-8a 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 | 13-8a | Support of Aperiodic SRS Resources for positioning | 1. Max number of aperiodic SRS Resources for positioning supported by UE across all SRS Resource Sets per BWP. Values = {64}, Other values FFS. | 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 FS 2. At least include {0,1} for FR1 band in a BC and {0,4} for FR2 band in a BC. |
| Qualcomm | Add the following values in component 1:   * Max number of aperiodic SRS Resources for positioning per BWP. Values = {1,2,4,8,16,32,64}   Add component 2:   * Max number of aperiodic SRS Resources for positioning per BWP per slot. Values = {1,2,3,4,5,6,8,10,12,14}   Per FS |
| vivo | * Per FS * On Huawei’s comment to have 0 as a value for component 1, we don’t think it is needed assuming there’s a capability signaling for FG 13-8a itself. |
| CATT | * Per FS * Component 1: Support {1, 2, 4, 8, 16, 32, 64}with 1,2,4,8,16,32 are added.. |
| ZTE | 1. Per FS 2. Component 1:Values = {1,2,4,8,16,32,64} |

# **13-8b: Support of Semi-persistent SRS Resources for positioning**

Based on agreements and [1], FG13-8b 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 | 13-8b | Support of Semi-persistent SRS Resources for positioning | 1. Max number of semi-persistent SRS Resources for positioning supported by UE across all SRS Resource Sets per BWP. Values = {64}, Other values FFS. | 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 FS 2. At least include {0,1} for FR1 band in a BC and {0,4} for FR2 band in a BC. |
| Qualcomm | Add the following values in component 1:   1. Max number of semi-persistent SRS Resources for positioning supported by UE per BWP. Values = {1,2,4,8,16,32,64}   Add component 2:   1. Max number of semi-persistent SRS Resources for positioning supported by UE per BWP per slot. Values = {1,2,3,4,5,6,8,10,12,14}   Per FS |
| vivo | * Per FS * On Huawei’s comment to have 0 as a value for component 1, we don’t think it is needed assuming there’s a capability signaling for FG 13-8b itself. |
| CATT | * Per FS * Component 1: Support {1, 2, 4, 8, 16, 32, 64}with 1,2,4,8,16,32 are added.. |
| ZTE | 1. Per FS 2. Component 1:Values = {1,2,4,8,16,32,64} |

# **13-9: OLPC for SRS for positioning based on PRS from the serving cell**

Based on agreements and [1], FG13-9 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 | 13-9 | OLPC for SRS for positioning based on PRS from the serving cell | 1. OLPC for SRS for positioning based on PRS from the serving cell | 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 with FR1/FR2 differentiation. |
| Qualcomm | Per band |
| vivo | Per band |
| CATT | Per band |
| ZTE | Per band |

# **13-9a: OLPC for SRS for positioning based on SSB from neighbouring cells**

Based on agreements and [1], FG13-9a 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 | 13-9a | OLPC for SRS for positioning based on SSB from neighbouring cells | 1. OLPC for SRS for positioning based on SSB from neighbouring cells | 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 with FR1/FR2 differentiation. |
| Qualcomm | Per band |
| vivo | Per band |
| CATT | Per band |
| ZTE | Per band |

# **13-9b: OLPC for SRS for positioning based on PRS from the neighbouring cells**

Based on agreements and [1], FG13-9b 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 | 13-9b | 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 | 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 with FR1/FR2 differentiation. |
| Qualcomm | Per band |
| vivo | Per band |
| CATT | Per band |
| ZTE | Per band |

# **13-9c: OLPC for SRS for positioning based on CSI-RS from serving cell**

Based on agreements and [1], FG13-9c 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 | 13-9c | OLPC for SRS for positioning based on CSI-RS from serving cell | 1. OLPC for SRS for positioning based on CSI-RS from serving cell | 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. Can be a component for the basic FG if introduced. 2. No dedicated signaling bit is required. |
| Qualcomm | Per band |
| vivo | Per band |
| CATT | Per band |
| ZTE | Per band |

# **[13-9d: OLPC for SRS for positioning based on SSB from serving cell]**

Based on agreements and [1], FG13-9d 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 | 13-9d | OLPC for SRS for positioning based on SSB from serving cell | 1. OLPC for SRS for positioning based on SSB from serving cell | 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. Can be a component for the basic FG if introduced. 2. No dedicated signaling bit is required. |
| Qualcomm | Per band |
| vivo | Per band |
| CATT | Per band |
| ZTE | Per band |

# **[13-9e: PathLoss estimate maintenance]**

Based on agreements and [1], FG13-9e 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 | 13-9e | PathLoss estimate maintenance | 1. Max number of monitored pathloss for SRS for positioning [across all cells] | TBD | No | N/A |  | [Per UE] | [No] | [No] | [N/A] |  | 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 for [across all cells]. 2. Values {0,1,4,8,16} 3. Suggest to change the component to “Maximum number of maintained pathloss estimates for SRS for positioning in addition to the 4 pathloss estimates per serving cell the UE maintains for PUSCH/PUCCH and other SRS transmissions” to align with agreement and spec. |
| Qualcomm | * Max Number of pathloss estimates that the UE can simultaneously maintain for all the SRS resource sets for positioning across all serving cells in addition to the up to four pathloss estimates that the UE maintains per serving cell for the PUSCH/PUCCH/SRS transmissions.   + Values = {0,1,4,8,16} * Max Number of pathloss estimates that the UE can simultaneously maintain for all the SRS resource sets for positioning per serving cell in addition to the up to four pathloss estimates that the UE maintains per serving cell for the PUSCH/PUCCH/SRS transmissions.   + Values = {0,1,4,8,16}   Per band |
| vivo | * Per band * Support Huawei’s comment to rename component 1 to be “Maximum number of maintained pathloss estimates for SRS for positioning in addition to the 4 pathloss estimates per serving cell the UE maintains for PUSCH/PUCCH and other SRS transmissions” to align with agreement and spec. * Assuming there’s a capability signaling for FG 13-9e itself, prefer the values for component 1 to be { 1, 4, 8, 16} |
| CATT | * Per band * We share the same view with Huawei to rename component 1 to make the name of Component 1 clear and avoid ambiguity, and we add “across all cells” in Huawei’s version. The updated name is “Maximum number of maintained pathloss estimates for SRS for positioning across all cells in addition to the 4 pathloss estimates per serving cell the UE maintains for PUSCH/PUCCH and other SRS transmissions”. * The brackets of Component 1 can be removed in the updated name. * We support the values for component 1 to be {1, 2, 4, 8, 16}. |
| ZTE | Agree with CATT. |

# **13-10: Spatial relation for SRS for positioning based on SSB from the serving cell**

Based on agreements and [1], FG13-10 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 | 13-10 | Spatial relation for SRS for positioning based on SSB from the serving cell | 1. Spatial relation for SRS for positioning based on SSB from the serving cell | 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. This FG is only applicable for FR2, and it can be a component for the basic FG if introduced. 2. No dedicated signaling bit is required. |
| Qualcomm | Per band in FR2 |
| vivo | Per band in FR2 |
| CATT | * Per band * Component 1 is only applicable for FR2. |
| ZTE | Per band in FR2 |

# **13-10a: Spatial relation for SRS for positioning based on CSI-RS from the serving cell**

Based on agreements and [1], FG13-10a 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 | 13-10a | Spatial relation for SRS for positioning based on CSI-RS from the serving cell | 1. Spatial relation for SRS for positioning based on CSI-RS from the serving cell | 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. This FG is only applicable for FR2, and it can be a component for the basic FG if introduced. 2. No dedicated signaling bit is required. |
| Qualcomm | Per band in FR2 |
| vivo | Per band in FR2 |
| CATT | * Per band * Component 1 is only applicable for FR2. |
| ZTE | Per band in FR2 |

# **13-10b: Spatial relation for SRS for positioning based on PRS from the serving cell**

Based on agreements and [1], FG13-10b 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 | 13-10b | Spatial relation for SRS for positioning based on PRS from the serving cell | 1. Spatial relation for SRS for positioning based on PRS from the serving cell | 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 with FR1/FR2 differentiation. 2. This FG is only applicable for FR2 |
| Qualcomm | Per band in FR2 |
| vivo | Per band in FR2 |
| CATT | * Per band * Component 1 is only applicable for FR2. |
| ZTE | Per band in FR2 |
|  |  |

# **13-10c: Spatial relation for SRS for positioning based on SRS**

Based on agreements and [1], FG13-10c 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 | 13-10c | Spatial relation for SRS for positioning based on SRS | 1. Spatial relation for SRS for positioning based on SRS | 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 with FR1/FR2 differentiation. 2. This FG is only applicable for FR2 |
| Qualcomm | Per band in FR2 |
| vivo | Per band in FR2 |
| CATT | * Per band * Component 1 is only applicable for FR2. |
| ZTE | Per band in FR2 |
|  |  |

# **13-10d: Spatial relation for SRS for positioning based on SSB from the neighbouring cell**

Based on agreements and [1], FG13-10d 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 | 13-10d | Spatial relation for SRS for positioning based on SSB from the neighbouring cell | 1. Spatial relation for SRS for positioning based on SSB from the neighbouring cell | 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 with FR1/FR2 differentiation. 2. This FG is only applicable for FR2 |
| Qualcomm | Per band in FR2 |
| vivo | Per band in FR2 |
| CATT | * Per band * Component 1 is only applicable for FR2. |
| ZTE | Per band in FR2 |
|  |  |

# **13-10e: Spatial relation for SRS for positioning based on PRS from the neighbouring cell**

Based on agreements and [1], FG13-10e 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 | 13-10e | 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 | 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 with FR1/FR2 differentiation. 2. This FG is only applicable for FR2 |
| Qualcomm | Per band in FR2 |
| vivo | Per band in FR2 |
| CATT | * Per band * Component 1 is only applicable for FR2. |
| ZTE | Per band in FR2 |
|  |  |

# **[13-10f: Spatial relation maintenance]**

Based on agreements and [1], FG13-10f 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 | 13-10f | Spatial relation maintenance | 1. Max number of [maintained] spatial relations for SRS for positioning [across all cells] | TBD | No | N/A |  | [Per UE] | [No] | [No] | [N/A] |  | 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 for [across all cells]. 2. Minimum value is 0. 3. Suggest to change the component to “Maximum number of active spatial relations for SRS for positioning in addition to those that the UE maintains for PUSCH/PUCCH and other SRS transmissions based on reported values in FG 2-60”. The wording “active” actually comes from the existing FG 2-60 in Rel-15.  |  |  | | --- | --- | | Active spatial relations | Maximum total number of {unique DL RS (except for aperiodic NZP CSI-RS) and SRS without spatial relation configured, and, TCI states available for DCI triggering of aperiodic NZP CSI-RS}, for indicating spatial domain transmit filter for PUCCH and SRS for PUSCH, per BWP per CC | |
| Qualcomm | * Component 1: Max Number of maintained spatial relations for all the SRS resource sets for positioning across all serving cells in addition to the spatial relations maintained spatial relations per serving cell for the PUSCH/PUCCH/SRS transmissions.   + Values = {0,1,2,4,8,16} * Component 2: Max Number of maintained spatial relations for all the SRS resource sets for positioning per serving cell in addition to the spatial relations maintained spatial relations per serving cell for the PUSCH/PUCCH/SRS transmissions.   + Values = {0,1,2,4,8,16} * Notes:   + Only applicable for FR2   + If the UE does not support this feature, no additional spatial relation for SRS for positioning are supported in addition to those maintained per serving cell for the PUSCH/PUCCH/SRS transmissions   Per band |
| vivo | * Per band in FR2 * Support remove the brackets of component 1: Max number of maintained spatial relations for SRS for positioning across all cells |
| CATT | * Per band * We share the same view with Huawei to rename component 1 to make the name of Component 1 clear and avoid ambiguity, and we add “across all cells” in Huawei’s version. The updated name is “Maximum number of active spatial relations for SRS for positioning across all cells in addition to those that the UE maintains for PUSCH/PUCCH and other SRS transmissions based on reported values in FG 2-60” to make the name of Component 1 clear and avoid ambiguity. * The brackets of Component 1 can be removed in the updated name. * We support the values for Component 1 to be {0, 1, 2, 4, 8, 16}. * Component 1 is only applicable for FR2. |
| ZTE | Agree with CATT. |

# **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 | 13-8 | SRS Resources for Positioning | 1. Max number of SRS Resource Sets for positioning supported by UE per BWP. Values = {1, 16}. Other values FFS 2. Max number of periodic SRS Resources for positioning supported by UE across all SRS Resource Sets per BWP. Values = {64}, Other values FFS. | 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 |
| 13. NR Positioning | 13-8a | Support of Aperiodic SRS Resources for positioning | 1. Max number of aperiodic SRS Resources for positioning supported by UE across all SRS Resource Sets per BWP. Values = {64}, Other values FFS. | 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 |
| 13. NR Positioning | 13-8b | Support of Semi-persistent SRS Resources for positioning | 1. Max number of semi-persistent SRS Resources for positioning supported by UE across all SRS Resource Sets per BWP. Values = {64}, Other values FFS. | 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 |
| 13. NR Positioning | 13-9 | OLPC for SRS for positioning based on PRS from the serving cell | 1. OLPC for SRS for positioning based on PRS from the serving cell | 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 | 13-9a | OLPC for SRS for positioning based on SSB from neighbouring cells | 1. OLPC for SRS for positioning based on SSB from neighbouring cells | 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 | 13-9b | 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 | 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 | 13-9c | OLPC for SRS for positioning based on CSI-RS from serving cell | 1. OLPC for SRS for positioning based on CSI-RS from serving cell | 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 | 13-10 | Spatial relation for SRS for positioning based on SSB from the serving cell | 1. Spatial relation for SRS for positioning based on SSB from the serving cell | 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 | 13-10a | Spatial relation for SRS for positioning based on CSI-RS from the serving cell | 1. Spatial relation for SRS for positioning based on CSI-RS from the serving cell | 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 | 13-10b | Spatial relation for SRS for positioning based on PRS from the serving cell | 1. Spatial relation for SRS for positioning based on PRS from the serving cell | 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 | 13-10c | Spatial relation for SRS for positioning based on SRS | 1. Spatial relation for SRS for positioning based on SRS | 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 | 13-10d | Spatial relation for SRS for positioning based on SSB from the neighbouring cell | 1. Spatial relation for SRS for positioning based on SSB from the neighbouring cell | 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 | 13-10e | 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 | 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 |

# **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.)