**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.

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| 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).**

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

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

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| 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).**

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

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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).**

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

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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).**

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

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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).**

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

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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).**

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# **[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].

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| 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).**

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# **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).**

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# **[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].

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| 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).**

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# **[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).**

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# **Conclusion**

TBD

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| 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 |
| 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}]
 | 13-3 (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 | 13-3 | 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}]
 | 13-3 (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 | 13-4 | 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}]
 | 13-3 (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 | 13-5 | 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}
2. Support of inter-frequency DL PRS RSRP measurement report in RRC\_CONNECTED state
 | 13-3, 13-5 (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 | 13-5a | 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} |
| 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} |

# **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.)