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

**e-Meeting, 20th – 30th April, 2020**

**Agenda item:** 7.2.11

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

**Title:** Summary on email discussion [100b-e-NR-UEFeatures-Remaining] NR positioning

**Document for:** Discussion and Decision

1. Introduction

This contribution summarizes the following email discussion in AI 7.2.11 regarding Rel-16 NR UE features.

[100b-e-NR-UEFeatures-Remaining] Email discussion/approval of remaining issues (especially the one identified as low priority items in FL’s summaries) starting no earlier than 4/30 till next meeting – Hiroki (DCM)/Ralf (ATT)

Companies are encouraged to check further updates for UE features list based on R1-2003073 shown below and provide feedback if any. Please note that the target of this email discussion is to reflect agreeable updates rather than solving any controversial discussion point. If there is any controversial discussion point, it should be discussed in the next RAN1 meeting.

1. NR positioning

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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, which is supported and reported by UE.

a) FR1 bands: {5, 10, 20, 40, 50, 80, 100}b) FR2 bands: {50, 100, 200, 400}1. DL PRS buffering capability: Type 1 or Type 2
2. Type 1 – sub-slot/symbol level buffering
3. Type 2 – slot level buffering
4. Duration of DL PRS symbols N 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.
5. T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms
6. N: {0.125, 0.25, 0.5, 1, 2, 4, 8, 12, 16, 20, 25, 30, 35, 40, 45, 50} ms

Notes:* 1. UE reports one combination of (N, T) values per band, where N is a duration of DL PRS symbols in ms processed every T ms for a given maximum bandwidth (B) in MHz supported by UE
	2. UE is not expected to support DL PRS bandwidth that exceeds the reported DL PRS bandwidth value
	3. UE DL PRS processing capability is defined for a single positioning frequency layer. UE capability for simultaneous DL PRS processing across positioning frequency layers is not supported in Rel.16 (i.e. for a UE supporting multiple positioning frequency layers, a UE is expected to process one frequency layer at a time)
	4. UE DL PRS processing capability is agnostic to DL PRS comb factor configuration
	5. The reporting of (N, T) values for maximum BW in MHz is not dependent on SCS
1. 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

Note: The above parameters are reported assuming a configured measurement gap and a maximum ratio of measurement gap length (MGL) / measurement gap repetition period (MGRP) of no more than X% (FFS: X).FFS case w/o measurement gap configured |  | 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 | 13-2 | 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, 2, 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 = {3, 6, 12, 24, 32, 64, 128, 256}1. Max number of DL PRS Resources per positioning frequency layer.

Values = {32, 64, 128, 256, 512, 1024}1. Max number of positioning frequency layers UE supports

Values = {1, 2, 3, 4}1. [Max number of DL PRS resources per TRP across all positioning frequency layers.

Value set: {4, 8, 16, 32, 64, 128}] | 13-1 | No | N/A |  | [Per UE] | N/A | [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}1. Max number of DL PRS Resources per DL PRS Resource Set.

Values = {1, 2, 4, 8, 16, 32, 64}1. Max number of DL PRS Resources 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 = {3, 6, 12, 24, 32, 64, 128, 256} 1. Max number of DL PRS Resources per positioning frequency layer.

Values = {32, 64, 128, 256, 512, 1024}1. Max number of positioning frequency layers UE supports

Values = {1, 2, 3, 4}1. [Max number of DL PRS resources per TRP across all frequency layers.

Value set: {4, 8, 16, 32, 64, 128}] | 13-1 | No | N/A |  | [Per UE] | N/A | [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}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 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 = {3, 6, 12, 24, 32, 64, 128, 256}1. Max number of DL PRS Resources per positioning frequency layer.

Values = {32, 64, 128, 256, 512, 1024}1. Max number of positioning frequency layers UE supports

Values = {1, 2, 3, 4}1. [Max number of DL PRS resources per TRP across all frequency layers.

Value set: {4, 8, 16, 32, 64, 128}] | 13-1 | Yes | N/A |  | [Per UE] | N/A | [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} | 13-2, | No | N/A |  | [Per UE] | N/A | [Yes] | 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
 | 13-5 | No | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported. | 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 RSTD measurements M per pair of TRPs with each measurement between a different pair of DL PRS resources or DL PRS resource sets, and the M measurements being performed on the same pair of TRPs

Values = {1, 2, 3, 4} | 13-3 | No | N/A |  | [Per UE] | N/A | [Yes] | 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
 | 13-6 | No | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported. | 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]

Note: Refers to Type-C for FR1 and Type-C & Type-D support for FR2 | 13-1 | No | N/A |  | [Per UE] | N/A | [Yes] | 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]

Note: Refers to Type-D support for FR2 | 13-1 | No | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 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, 2, 4, 8, 12, 16}.1. Max number of P/SP/AP SRS Resources for positioning per BWP.

Values = {1,2,4,8,16,32,64}1. [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}]1. [Max number of periodic SRS Resources for positioning supported by UE across all SRS Resource Sets per BWP.

Values = {1, 2, 4, 8, 16, 32, 64}]1. [Max number of periodic SRS Resources for positioning per BWP.

 Values = {1,2,4,8,16,32,64}]1. [Max number of periodic SRS Resources for positioning per BWP per slot.

Values = {1,2,3,4,5,6,8,10,12,14}] | NA | Yes | N/A |  | [Per FS] | 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 per BWP.

Values = {1,2,4,8,16,32,64}1. [Max number of aperiodic SRS Resources for positioning per BWP per slot.

 Values = {1,2,3,4,5,6,8,10,12,14}] | 13-8 | Yes | N/A |  | [Per FS] | 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 per BWP.

Values = {1,2,4,8,16,32,64}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}] | 13-8 | Yes | N/A |  | [Per FS] | 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
 | At least one from 13-2 to 13-413-8 | 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
 | 13-8, [13-9d] | 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
 | 13-8, 13-9 | 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
 | 13-8 | 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 | 13-9d | OLPC for SRS for positioning based on SSB from serving cell | 1. [OLPC for SRS for positioning based on SSB from serving cell]
 | 13-8 | 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 | 13-9e | [PathLoss estimate maintenance] | 1. [Max number of pathloss estimates that the UE can simultaneously maintain for all the SRS resource sets for positioning across all cells in addition to the up to four pathloss estimates that the UE maintains per serving cell for the PUSCH/PUCCH/SRS transmissions.

Values = {1,4,8,16}]1. [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 = {1,4,8,16}] | At least one from 13-9, 13-9a,b,c,[d] | No | N/A |  | [Per band]  | N/A | N/A | N/A |  | 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
 | 13-8 | No | N/A |  | [Per band] | N/A | N/A (FR2 only) | 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
 | 13-10 | No | N/A |  | [Per band] | N/A | N/A (FR2 only) | 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
 | At least one from 13-2 to 13-4, 13-8 | No | N/A |  | [Per band] | N/A | N/A (FR2 only) | 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
 | 13-8, | No | N/A |  | [Per band] | N/A | N/A (FR2 only) | 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
 | 13-10 | No | N/A |  | [Per band] | N/A | N/A (FR2 only) | 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
 | 13-10b | No | N/A |  | [Per band] | N/A | N/A (FR2 only) | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | [13-10f] | [Spatial relation maintenance] | 1. [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}]1. [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}] | At least one from 13-10, 13-10a, b, d, e | No | N/A |  | [Per band] | N/A | N/A (FR2 only) | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-11a | Inter-frequency measurement for Multi-RTT | 1. Inter-frequency measurement for Multi-RTT
 | 13-4, 13-8 | Yes | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | [13-11] | [UE Rx-Tx Measurement Report for Multi-RTT] | 1. Max number of UE Rx–Tx time difference measurements corresponding to a single SRS resource/resource set for positioning with each measurement corresponding to a single DL PRS resource/resource set.

Note: The DL PRS resource/resource sets can be in different positioning frequency layers | 13-4, 13-8 | No | N/A |  | [Per UE] | [N/A] | [Yes] | [N/A] | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | [13-12] | [NR E-CID DL SSB RRM measurements with LPP support for NR Positioning] | 1. [NR E-CID DL SSB RRM measurements with LPP support for NR Positioning]
 |  | 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 | [13-12a] | [NR E-CID DL CSI-RS RRM measurements with LPP support for NR Positioning] | 1. [NR E-CID DL CSI-RS RRM measurements with LPP support for NR Positioning]
 | 13-12 | 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 | 13-13 | Simultaneous DL-AoD and DL-TDoA processing | 1. Support of simultaneous processing for DL AoD and DL TDoA measurements

If it is not indicated, a UE is not expected to perform simultaneously the processing for deriving DL AoD and DL TDoA measurements  | 13-2, 13-3 | No | N/A |  | [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 | 13-14 | Simultaneous DL-AoD and Multi-RTT processing | 1. Support of simultaneous processing for DL AoD and Multi-RTT measurements

If it is not indicated, a UE is not expected to perform simultaneously the processing for deriving DL AoD and M-RTT measurements  | 13-2, 13-4, 13-8 | No | N/A |  | [Per UE] | [N/A] | [N/A] | [N/A] | Need for location server to know if the feature is supported. | Optional with capability signaling |

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