**3GPP TSG RAN WG1 #101 R1-20xxxxx**

**e-Meeting, May 25th – June 5th, 2020**

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

**Title:** **Summary on [101-e-NR-UEFeatures-Positioning-02]**

**Agenda Item:** **7.2.11.8**

**Document for:** **Discussion and Decision**

1. Introduction

This contribution summarizes the following email discussion/approval regarding UE features for Positioning.

[101-e-NR-UEFeatures-positioning-02] Email discussion/approval on capability signaling design for existing FGs for NR positioning (25th May – 2nd June) – (DCM, Hiroki)

* Discuss and decide capability signaling design (including components, candidate values, reporting type, xDD/FRx differentiations) for existing FGs and for already agreed new FGs (simultaneous SRS transmission for intra/inter-band CA)
* Discuss and decide any other necessary update for the UE features list for NR positioning based on identified issues/proposals in R1-2004408
1. Discussion on UE features for NR positioning

## 2.1 FG13-1

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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, [6], 8, 12, 16, [24], 32, [48], 64} for each SCS: 15kHz, 30kHz, 60kHz
	2. FR2 bands: {1, 2, 4, [6], 8, 12, 16, [24], 32, [48], 64} for each SCS: 60kHz, 120kHz

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 |

* **Components for FG13-1**
	+ **Component 3**
		- **Remove component 3 because it can be pre-defined: [7]**
		- **The second Note “The above parameters…” should be merged with component 3: [10]**
	+ **Component 4**
		- **Remove all square braket values: [4]**
		- **Add one value between 32 and 64 such as 48 for both FR1 and FR2: [9]**
	+ **Add new component**
		- **Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz assuming no configured measurement gap and a maximum ratio of measurement window / T of no more than X% (FFS: X): [10]**
		- **The max number of frequency layers per UE across FR1/FR2: [11]**
	+ **Confirm values for all components: [6]**
* **Prerequisite feature groups**
	+ **N/A: [6]**
* **Need for the gNB to know if the feature is supported**
	+ **Yes: [3], [11], [12]**
	+ **No: [10]**
* **Reporting type**
	+ **Per band: [3], [6], [11], [12], [13]**
* **Note**
	+ **The Notes (a-e) in component 3 should be moved to “Note” column: [13]**
	+ **The Notes (c-e) in component 3 should be moved to “Note” column: [10]**
	+ **Add new notes: If a UE reports supporting of (N, T), then the UE supports also (N, T)\*2^k, where k is non-positive integer provided that N\*2^k is supported by the numerology of PRS and T\*2^k is an supported PRS resource set periodicity: [5]**
	+ **FFS value X**
		- **X = 30%: [5]**
		- **X = 1/3: [11]**
		- **X = {10%, 20%, 30%}: [6]**
		- **Need not be reported by the UE: [13]**
	+ **Remove the case w/o measurement gap configured: [2], [3], [6], [9], [13]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [2] | We suggest to remove “FFS case w/o measurement gap configured” at the end of components description. |
| [3] | For FG13-1, suggest to remove “FFS case w/o measurement gap configured”, additional FG for the case w/o measurement gap is not recommended.

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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, [6], 8, 12, 16, [24], 32, [48], 64} for each SCS: 15kHz, 30kHz, 60kHz
	2. FR2 bands: {1, 2, 4, [6], 8, 12, 16, [24], 32, [48], 64} for each SCS: 60kHz, 120kHz

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). |  | 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 |

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| [4] | Component 4: Support Values:1. FR1 bands: {1, 2, 4, 8, 12, 16, 32, 64} for each SCS: 15kHz, 30kHz, 60kHz
2. FR2 bands: {1, 2, 4, 8, 12, 16, 32, 64} for each SCS: 60kHz, 120kHz
 |
| [5] | **Proposal 1**: For FG 13-1* MGL/MGRP < X%, where X = 30%
* Add the following to the notes: If a UE reports supporting of (N, T), then the UE supports also (N, T)\*2^k, where k is non-positive integer provided that N\*2^k is supported by the numerology of PRS and T\*2^k is an supported PRS resource set periodicity

For example, suppose the numerology is SCS = 15kHz. If a UE reports supporting of (N, T) = (8ms, 160ms), then the UE also supports (N, T) = (4ms, 80ms), (2ms, 40ms), and (1ms, 20ms). |
| [6] | * FG 13-1
	+ Pre-requisite: NA
	+ Type of signaling: Per band
	+ 13-1 Commom DL PRS processing capabilities
		- Value of X

Regarding the value X - maximum ratio of measurement gap length (MGL) to measurement gap repetition period (MGRP) we propose to support a set of values {10%, 20%, 30%} so that UE can pick the one and report together with N and T settings for maximum supported BW. The proposed set of values covers MG patterns supported by RAN4 WG.**Proposal 4: Define set of X values {10%, 20%, 30%}, so that UE reports one of them together with other DL PRS processing capabilities*** + - Case w/o MG Configured

Regarding, DL PRS processing capabilities for the case of no MG configured we are not sure that there is a need to define those. The potential issues we see is that UE can be scheduled with data transmissions in DL and UL and in case if some processing resources are shared it may be difficult to predict and analyze processing time since it may dependns on intensity of traffic, allocations sizes as well as beam management/switching procedures, etc. In addition, the actual size of the active BWP is anyway not known to LMF. In general, it is possible to make some assumptions on processing BW, reuse of hardware resources for data and DL PRS processing and even fix a value of traffic intensity, assume that data allocation size is equal to the BW of active BWP. However even if all these details are to be discussed it may still be difficult to derive reasonable numbers. It should be also point out that decision on data scheduling is under gNB control and thus LMF will have no idea on what is happening over the air.**Proposal 5:** **Do not introduce DL PRS processing capabilities for the case when no MG configured*** + - Component Values

**Proposal 6: Confirm values for all components under FG 13-1** |
| [7] | In our companion contribution [1], we have discussed if UE DL PRS processing capability is agnostic to the configured SCS settings of DL PRS and following the same principle, the reported values of T should be the same within an FR. Therefore, we have the following proposal***Proposal 1:*** *For UE DL PRS processing capability, UE may report the maximum PRS bandwidth BWmax and (N, T) for each SCS. The reported value for N should include the impact of cell phase synchronization error between TRPs. The UE DL PRS processing capability is not exactly scaled inversely proportional to DL PRS processing bandwidth.* * ***Option 1:*** *UE reports the capability corresponding to maximum PRS bandwidth to be supported. Scaling rule in Table 2 is applied to interpret UE’s capability if network configures smaller BW.*
* ***Option 2:*** *UE reports multiple PRS bandwidth values to indicate scaling boundaries.*

The duration of DL PRS symbol in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz can be pre-defined and thus there is no need to introduce signaling for this purpose. ***Proposal 4****: The duration of DL PRS symbol in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz can be pre-defined.* |
| [8] | In RAN1#100bis-e meeting, we made the following agreement on DL PRS processing UE capability:

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| Agreement: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
 |

Accordingly, in UE feature, FG 13-1 Common DL PRS processing capability is defined with a note that the parameters are reported with assuming a configured measurement gap. However, the UE would have different behavior for the cases when measurement gap is configured and not configured. For instance, when the measurement gap is not configured, the UE may need to process PDCCH/PDSCH too, while when the measurement gap is configured, the UE may not need to process signals other than DL PRS.Therefore, we need specify the case when measurement gap is not configured. For that we can consider two alternatives. One option is that we can add one new FG, FG13-1a, for the UE to report common DL processing capability by assuming measurement gap not configured. Another option is to clarify that the UE can expect measurement gap is always configured for processing DL PRS resource.Proposal 1: For the UE processing DL PRS capability, support one of the following options:* Option 1: add a new FG, FG13-1a, for the UE to report common DL processing capability with assuming that measurement gap is not configured.
* Option 2: clarify that the UE can expect measurement gap for processing DL PRS is always configured.
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| [9] | * For component 4, the maxim number of resources could be different according to UE implementation, the reporting granularity seems is not uniform so difference between 32 and 64 is too high, we prefer adding one value between 32 and 64 such as 48 for both FR1 and FR2.
* For “FFS case w/o measurement gap configured”, we do not support establishing DL PRS processing capability for the case without measurement gap.
	+ As we mentioned in companion contribution [2], when the measurement gap is not configured, the UE needs to share hardware resource to process DL PRS and other signals, but it is difficult to clearly quantify the amount of hardware resources to be used to respectively process data and PRS from the perspective of RAN1. Furthermore, expecting the amount of data scheduling is difficult since it is dynamic and hence, DL PRS processing capability might be time varying depending on the amount of data which need to be processed. Thus, it seems not reasonable to define a separate DL PRS processing capability especially for the case where measurement gap is not configured. The already defined PRS processing capability could be used as the upper bound of DL PRS processing capability.
 |
| [10] | * For FG13-1
	+ Need for the gNB to know should be “No”.
	+ Component 3: The Notes (c-e) should be moved to “Note” column.
	+ The second Note “The above parameters…” should be merged with component 3, so that component 3 reads
		- 3. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz 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).
	+ New Component:
		- Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz assuming no configured measurement gap and a maximum ratio of measurement window / T of no more than X% (FFS: X).
 |
| [11] | The max number of layers that are configured to the UE should be reported across all methods. So, we consider it as part of the “Common PRS capabilities”. Note that the fact that this capability is reported per band, it does NOT mean that the UE can report different value per band or that the number of layers scale with the number of bands. For example, we can agree that if the UE supports PRS processing in two bands, then the same total number of bands needs to be reported. The minimum capability for a UE in Rel-16 should be that 1 positioning frequency layer across all bands in FR1/FR2. ***Proposal 2: The max number of frequency layers per UE across FR1/FR2 should be defined across positioning methods inside the 13-1 row. UE reports the same value for all bands across both FR1/FR2.******Proposal 3: Introduce a separate PRS processing capability without MG configured (reported per band) in which the UE can at least report, if supports this feature, a component for (N,T) and number of PRS resources per slot.*** * ***The same maximum ratio of PRS Length to PRS periodicity should be assumed with the maximum MGL/MGRP for the case of PRS processing with MG.***
* ***If this is not agreeable, conclude that PRS processing without MG is not supported in NR Rel-16.***

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| 13. NR Positioning | 13-1 | Common DL PRS Processing Capability with MG | 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, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz
	2. FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz

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 1/3.1. Max number of positioning frequency layers UE supports across all methods and FR1/FR2 bands.

Values = {1, 2, 3, 4} |  | 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 | 13-1a | Common DL PRS Processing Capability without MG | 1. 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.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

2.Max number of DL PRS resources that UE can process in a slot under it* 1. FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz
	2. FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz

Note: The above parameters are reported assuming a maximum ratio of PRS instance length and PRS periodicity of no more than 1/3. | 13-1 | 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 |
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| [12] |

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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
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5. T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms
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	1. FR1 bands: {1, 2, 4, [6], 8, 12, 16, [24], 32, [48], 64} for each SCS: 15kHz, 30kHz, 60kHz
	2. FR2 bands: {1, 2, 4, [6], 8, 12, 16, [24], 32, [48], 64} for each SCS: 60kHz, 120kHz

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 |

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| [13] | Proposal 1 Agree on ‘per Band’ signaling for feature group 13-1, and move the list of Notes a-e under component 3 to the Notes column. One of the issues to be resolved concern the following note for this feature group:

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| 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). |

Our view on this is that RAN1 should only point to RAN4 specification for X. RAN4 has specified in 38.133 the list of applicable gap patterns and carrier specific scaling factors (CSSF) and X should be derived from these. Therefore, X need not be reported by the UE.Proposal 2 The maximum ratio of MGL/MGRP is not signaled to any network node, but determined by the requirements and rules in TS 38.133, e.g., applicability rules for different measurement gap patterns, gap sharing rules, CSSF, etc. |

Based on above, following FL proposals are made.

### **FL proposal 1:**

* **FFS text in components of FG13-1 is removed**
* **Notes for component 3 of FG13-1 is moved to Note column**
* **Add 48 as candidate value of component 4 of FG13-1 and other values in brackets are removed**
* **Change “X%” to “30%” for FG13-1 (depending on [101-e-NR-Pos-01])**

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5. T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms
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7. Max number of DL PRS resources that UE can process in a slot under it
	1. FR1 bands: {1, 2, 4, 8, 12, 16, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz
	2. FR2 bands: {1, 2, 4, 8, 12, 16, 32, 48, 64} for each SCS: 60kHz, 120kHz

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 30% |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Need for location server to know if the feature is supported.Notes for component 3:a) 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 UEb) UE is not expected to support DL PRS bandwidth that exceeds the reported DL PRS bandwidth valuec) 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)d) UE DL PRS processing capability is agnostic to DL PRS comb factor configuratione) The reporting of (N, T) values for maximum BW in MHz is not dependent on SCS | Optional with capability signaling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| Moderator (NTT DOCOMO) | Value of X will be discussed in [101-e-NR-Pos-01], and then the outcome of the discussion can be reflected here. |
| Huawei/HiSilicon | X% should not be changed to 30%.Need for gNB to know should be No |
| Qualcomm | We would like to keep value 6 and 24 in Component 4.  |
| MTK | 1. Need for gNB to know: NO

The PRS configuration from LMF to UE is related to this FG, so UE suffices to signal this FG to LMF, and UE doesn’t need to signal this FG to gNB.1. For component 3, we would like to add N = 32
2. [Max number of positioning frequency layers UE supports] can be added here to reflect the number of POS frequency layers UE supports per band
 |

## 2.2 FG13-2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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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****(the ‘type’ definition from UE features should be based on the granularity of 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}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, [16], 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}] | 13-1 | No | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported.FFS: split of candidate values for FR1/FR2/mixed FR1-FR2 for each component | Optional with capability signaling |

* **Components for FG13-2**
	+ **Component 2**
		- **Remove value 1: [3], [4], [5], [7], [9], [10]**
		- **Add value 2: [12]**
		- **Split the values: [10]**
			* **Do not split candidate values among components: [6]**
	+ **Component 3**
		- **Split the values: [10]**
			* **Do not split candidate values among components: [6]**
	+ **Component 4**
		- **Keep value 3: [3], [4], [7]**
		- **Add values: [12]**
		- **Change the description as “Max number of TRPs across all positioning frequency layers ~~per UE~~.”: [9]**
	+ **Component 5**
		- **Split the values: [10]**
			* **Do not split candidate values among components: [6]**
	+ **Component 6**
		- **Remove the bracket: [6], [9]**
		- **Remove the component 6: [11], [13]**
	+ **Confirm values for all components: [6]**
* **Pre-requisite**
	+ **FG 13-1: [6]**
* **Type of signaling**
	+ **Per band: [11]**
	+ **Per UE: [3], [4], [5], [6], [7], [13]**
* **Need of FR1/FR2 differentiation**
	+ **N/A: [11]**
	+ **Yes: [12]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| [3] | * Per UE and differentiated for FR1 and FR2.
* For component 2, suggest remove value 1.
* For component 4, the value 3 should be reserved for low cost UE.

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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}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, [16], 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}] | 13-1 | No | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported.FFS: split of candidate values for FR1/FR2/mixed FR1-FR2 for each component | Optional with capability signaling |

 |
| [4] | * Per UE
* Component 2: Support Values: {2, 4, 8, 16, 32, 64}
* Component 4: Support Values: {3, 6, 12, 24, 32, 64, 128, 256}
 |
| [5] | **Proposal 2**: For FG 13-2* It is signalled per UE, with values for FR1/FR2/mixed FR1-FR2 for each component
* component 2, remove the value 1, since DL-AoD will not work with only one PRS resource per PRS resource set
 |
| [6] | * FG 13-2
	+ Pre-requisite: 13-1
	+ Type of signaling: Per UE
	+ Keep component 6 (max number of positioning frequency layers UE supports) within each FG and further discuss whether it is common across DL-AoD, DL-TDoA and multi-RTT or not
	+ Do not split candidate values among components
	+ Confirm set of values for each component
 |
| [7] | * Per UE
* Component 2: the value 1 shall be kept since the UE might report supporting 2 in component 1. Furthermore, it is ok to differentiate the value of component 2 for FR1 and FR2.
* Component 4: support to keep 3 as minimum value
 |
| [9] | * For component 2, we suggest removing the square bracket. The number of maximum number of DL PRS resources per DL PRS resource set does not need to be different depending on the NR positioning techniques. As supported in FG 13-3 and 13-4, we need to support 1 as the maximum number of resource per DL PRS resource set.
* For component 4, we think that description on component 4 needs to be changed as follows: “Max number of TRPs across all positioning frequency layers ~~per UE~~.” since the “type” for this FG is still FFS. Among the possible values, we suggest that 3 needs to be added, since some UEs can support the minimum number of TRPs so that they can support DL-TDOA and Multi-RTT technique.
* For component 6, the candidate values seems enough, so we prefer removing square bracket.
 |
| [10] | * For FG13-2
	+ Component 2: 1 should not be supported, as single PRS resource per set will not work for DL-AoD. Suggest to split with the following 2 values
		- FR1: {2, 4, 8}
		- FR2: {2, 8, 16, 64}
	+ Component 3: Suggest to split with the following 4 values
		- FR1 only: minimum value should be 6, i.e, {6, 24, 128, 512}
		- FR2 only: minimum value should be 24, i.e. {24, 96, 512, 2048}
		- FR1 in mixed FR1-FR2: minimum value should be 6, i.e. {6, 24, 64, 256}
		- FR2 in mixed FR1-FR2: minimum value should be 24, i.e. {24, 96, 256, 1024}
	+ Component 5: Suggest to split with the following 2 values
		- FR1: minimum values should be 6, i.e. {6, 24, 128}
		- FR2: minimum value should be 24, i.e. {24, 96, 512}
 |
| [11] |

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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}1. Max number of DL PRS Resources per DL PRS Resource Set

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

Values = {32, 64, 128, 256, 512, 1024} | 13-1 | No | N/A |  | Per band | N/A | N/A | N/A | Need for location server to know if the feature is supported.FFS: split of candidate values for FR1/FR2/mixed FR1-FR2 for each component | Optional with capability signaling |

 |
| [12] |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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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}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, [16], 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}] | 13-1 | No | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported.FFS: split of candidate values for FR1/FR2/mixed FR1-FR2 for each component | Optional with capability signaling |

 |
| [13] | In our view, the Max number of positioning frequency layers UE supports should not depend on the methods and could be moved to feature 13-1. Proposal 3 Remove component 6 (Max number of positioning frequency layers UE supports) from Feature groups 13-2, 13-3 and 13-4. Introduce Max number of positioning frequency layers UE supports as a component in Feature group 13-1. Furthermore, we support Per UE signaling for feature groups 13-2,13-3,13-4.Proposal 4 support Per UE signaling for feature groups 13-2,13-3,13-4. |

Based on above, following FL proposals are made.

### **FL proposal 2:**

* **The value “[1]” in component 2 of FG13-2 is removed**
* **The value “[3]” in component 4 of FG13-2 is kept, and the value “[16]” in component 4 of FG13-2 is removed**
* **The component 6 of FG13-2 is kept**
* **Type of FG13-2 is “Per UE”**
	+ **Need of FDD/TDD differentiation is “No”**
	+ **Need of FR1/FR2 differentiation is “Yes”**

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| 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 = {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} | 13-1 | No | N/A |  | Per UE | No | Yes | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Suggest to have the following, and change FR1/FR2 differentiation to “No”.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 for FR1

Values = {2, 4, 8}1. Max number of DL PRS Resources per DL PRS Resource Set for FR2

Values = {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 for FR1-only.

Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only. (optional)

Values = {24, 96, 192, 256, 512, 1024, 2048}1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation.

Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation.

Values = {24, 96, 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 FR1 positioning frequency layer.

Values = {6, 24, 128, 256, 512, 1024}1. Max number of DL PRS Resources per FR2 positioning frequency layer.

Values = {24, 64, 96, 128, 256, 512, 1024}1. Max number of positioning frequency layers UE supports

Values = {1, 2, 3, 4} |
| Qualcomm | * For Component 4: 3 should not be supported as a minimum value. It is too low and we risk having bad performance.
* We think it should be reported “per-band” at least for the purpose of licensed/unlicensed band differentiation and for the IODT purposes.
* The “max number of frequency layers” corresponds to the layers that are supported by the UE across all bands & FR1/FR2 & methods. In other words, the minimum capability of NR Positioning should be 1 layer across all methods and bands. For this reason, we do believe that it should be part of the 13-1
 |
| Huawei/HiSilicon2 | Reply to QC:* Adding small numbers will be future proof so that we do not need to introduce reduced capability UE in future LPP operation. This may result in the bad performance, but it is more like a deployment option.
* With PRS processing capability reported per band, and if UE does not support band n46, UE simply does not support UE processing capability in band n46. Resource capability reported per UE can work fine.
* 13-1 is reported per band, but even QC mentioned that the number of positioning frequency layer is the total number across all bands; how can it be interpreted?
 |
| MTK | 1. The FG is per UE. Each component may or may not have different values with FR differentiation.
2. Componenet 6 (max number of positioning frequency layers UE supports) is reported considering the following 4 scenarios:

FR1-only, FR2-only, FR1 in FR1/FR2 mixed operation, and FR2 in FR1/FR2 mixed operation.1. To QC’s concern, maybe we can add a note that this FG considering only licensed band. Positioning under unlicensed band is not in the discussion scope, isn’t it?
2. Support the values provided in HW’s comments 1,2,3 (in the first row of this table)
3. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1.

Values = {6, 24, 64, 128, 192, 256, 512}1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2:

Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}1. For component 4, we would like to keep the value 16, i.e., max number of TRPs across all positioning frequency layers per UE:

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

Values = {32, 64, 128} for FR1Values = {32, 64, 128, 256, 512, 1024} for FR2 |
| Nokia, NSB | The FG type should be per UE, we are open to FRx differentiation if needed. |

## 2.3 FG13-3

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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****(the ‘type’ definition from UE features should be based on the granularity of 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}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, [16], 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}] | 13-1 | No | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported.FFS: split of candidate values for FR1/FR2/mixed FR1-FR2 for each component | Optional with capability signaling |

* **Components for FG13-3**
	+ **Component 2**
		- **Split the values: [10]**
			* **Do not split candidate values among components: [6]**
	+ **Component 3**
		- **Split the values: [10]**
			* **Do not split candidate values among components: [6]**
	+ **Component 4**
		- **Keep value 3: [3], [4], [7]**
		- **Change the desvription as “Max number of TRPs across all positioning frequency layers ~~per UE~~.”: [9]**
	+ **Component 5**
		- **Split the values: [10]**
			* **Do not split candidate values among components: [6]**
	+ **Component 6**
		- **Remove the bracket: [6], [9]**
		- **Remove the component 6: [11], [13]**
	+ **Confirm values for all components: [6]**
* **Pre-requisite**
	+ **FG 13-1: [6]**
* **Type of signaling**
	+ **Per band: [4], [11]**
	+ **Per UE: [3], [5], [6], [7], [13]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

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| [3] | * Per UE and differentiated for FR1 and FR2.
* For component 4, the value 3 should be reserved for low cost UE.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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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}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, [16], 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}] | 13-1 | No | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported.FFS: split of candidate values for FR1/FR2/mixed FR1-FR2 for each component | Optional with capability signaling |

 |
| [4] | * Per band
* Component 4: Support Values: {3, 6, 12, 24, 32, 64, 128, 256}
 |
| [5] | **Proposal 3**: For FG 13-3* It is signalled per UE, with values for FR1/FR2/mixed FR1-FR2 for each component
 |
| [6] | * FG 13-3
	+ Pre-requisite: 13-1
	+ Type of signaling: Per UE
	+ Keep component 6 (max number of positioning frequency layers UE supports) within each FG and further discuss whether it is common across DL-AoD, DL-TDoA and multi-RTT or not
	+ Do not split candidate values among components
	+ Confirm set of values for each component
 |
| [7] | * Per UE
* Component 4: support to keep 3 as minimum value
 |
| [9] | * For component 4, we think that description on component 4 needs to be changed as follows: “Max number of TRPs across all positioning frequency layers ~~per UE~~.” since the “type” for this FG is still FFS. Among the possible values, we suggest that 3 needs to be added, since some UEs can support the minimum number of TRPs so that they can support DL-TDOA and Multi-RTT technique.
* For component 6, the candidate values seems enough, so we prefer removing square bracket.
 |
| [10] | * For FG13-3
	+ Component 2: suggest to split with the following 2 values
		- FR1: {1, 2, 4, 8}
		- FR2: {1, 8, 16, 64}
	+ Component 3: Suggest to split with the following 4 values
		- FR1 only: minimum value should be 3, i.e, {3, 24, 128, 512}
		- FR2 only: minimum value should be 24, i.e. {24, 96, 512, 2048}
		- FR1 in mixed FR1-FR2: minimum value should be 3, i.e. {3, 24, 64, 256}
		- FR2 in mixed FR1-FR2: minimum value should be 24, i.e. {24, 96, 256, 1024}
	+ Component 5: Suggest to split with the following 2 values
		- FR1: minimum values should be 3, i.e. {3, 24, 128}
		- FR2: minimum value should be 24, i.e. {24, 96, 512}
 |
| [11] |

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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}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 = {12, 16, 24, 32, 64, 128, 256} 1. Max number of DL PRS Resources per positioning frequency layer.

Values = {32, 64, 128, 256, 512, 1024} | 13-1 | No | N/A |  | Per band | N/A | N/A | N/A | Need for location server to know if the feature is supported.FFS: split of candidate values for FR1/FR2/mixed FR1-FR2 for each component | Optional with capability signaling |

 |
| [12] |

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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}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, [16], 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}] | 13-1 | No | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported.FFS: split of candidate values for FR1/FR2/mixed FR1-FR2 for each component | Optional with capability signaling |

 |
| [13] | In our view, the Max number of positioning frequency layers UE supports should not depend on the methods and could be moved to feature 13-1. Proposal 3 Remove component 6 (Max number of positioning frequency layers UE supports) from Feature groups 13-2, 13-3 and 13-4. Introduce Max number of positioning frequency layers UE supports as a component in Feature group 13-1. Furthermore, we support Per UE signaling for feature groups 13-2,13-3,13-4.**Proposal 4 support Per UE signaling for feature groups 13-2,13-3,13-4.** |

Based on above, following FL proposals are made.

### **FL proposal 3:**

* **The value “[3]” in component 4 of FG13-3 is kept, and the value “[16]” in component 4 of FG13-3 is removed**
* **The component 6 of FG13-3 is kept**
* **Type of FG13-3 is “Per UE”**
	+ **Need of FDD/TDD differentiation is “No”**
	+ **Need of FR1/FR2 differentiation is “Yes”**

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| 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} | 13-1 | No | N/A |  | Per UE | No | Yes | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Suggest to have the following, and change FR1/FR2 differentiation to “No”.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 for FR1.

Values = {1, 2, 4, 8}1. Max number of DL PRS Resources per DL PRS Resource Set for FR2.

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 for FR1-only.

Values = {3, 24, 64, 128, 192, 256, 512, 1024, 2048}1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only. (optional)

Values = {24, 96, 192, 256, 512, 1024, 2048}1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation.

Values = {3, 24, 64, 128, 192, 256, 512, 1024, 2048}1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation.

Values = {24, 96, 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 FR1 positioning frequency layer.

Values = {3, 24, 128, 256, 512, 1024}1. Max number of DL PRS Resources per FR2 positioning frequency layer.

Values = {24, 64, 96, 128, 256, 512, 1024}1. Max number of positioning frequency layers UE supports

Values = {1, 2, 3, 4} |
| Qualcomm | * Component 4: 3 should not be supported as a minimum value. It is too low and we risk having bad performance.
* We think it should be reported “per-band” at least for the purpose of licensed/unlicensed band differentiation and for the IODT purposes.
* The “max number of frequency layers” corresponds to the layers that are supported by the UE across all bands & FR1/FR2 & methods. In other words, the minimum capability of NR Positioning should be 1 layer across all methods and bands. For this reason, we do believe that it should be part of the 13-1
 |
| Huawei/HiSilicon2 | Small changes to the previous comment on the numbersReply to QC:* Adding small numbers will be future proof so that we do not need to introduce reduced capability UE in future LPP operation. This may result in the bad performance, but it is more like a deployment option.
* With PRS processing capability reported per band, and if UE does not support band n46, UE simply does not support UE processing capability in band n46. Resource capability reported per UE can work fine.
* 13-1 is reported per band, but even QC mentioned that the number of positioning frequency layer is the total number across all bands; how can it be interpreted?
 |
| MTK | 1. The FG is per UE. Each component may or may not have different values with FR differentiation.
2. Componenet 6 (max number of positioning frequency layers UE supports) is reported considering the following 4 scenarios:

FR1-only, FR2-only, FR1 in FR1/FR2 mixed operation, and FR2 in FR1/FR2 mixed operation.1. To QC’s concern, maybe we can add a note that this FG considering only licensed band. Positioning under unlicensed band is not in the discussion scope, isn’t it?
2. Support the values provided in HW’s comments 1,2,3 (in the first row of this table)
3. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1.

Values = {6, 24, 64, 128, 192, 256, 512}1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2:

Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}1. For component 4, we would like to keep the value 16, i.e., max number of TRPs across all positioning frequency layers per UE:

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

Values = {32, 64, 128} for FR1Values = {32, 64, 128, 256, 512, 1024} for FR2 |
| Nokia, NSB | We agree with FL proposal that FG type is per UE. It is not completely clear if there is a need for FRx differentiation in this case. |

## 2.4 FG13-4

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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****(the ‘type’ definition from UE features should be based on the granularity of 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}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], [16], 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}] | 13-1 | Yes | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported.FFS: split of candidate values for FR1/FR2/mixed FR1-FR2 for each component | Optional with capability signaling |

* **Components for FG13-4**
	+ **Component 2**
		- **Split the values: [10]**
			* **Do not split candidate values among components: [6]**
	+ **Component 3**
		- **Split the values: [10]**
			* **Do not split candidate values among components: [6]**
	+ **Component 4**
		- **Keep value 3: [3], [4], [7]**
		- **Remove values 3 and 6: [11]**
		- **Change the desvription as “Max number of TRPs across all positioning frequency layers ~~per UE~~.”: [9]**
	+ **Component 5**
		- **Split the values: [10]**
			* **Do not split candidate values among components: [6]**
	+ **Component 6**
		- **Remove the bracket: [6], [9]**
		- **Remove the component 6: [11], [13]**
	+ **Confirm values for all components: [6]**
* **Pre-requisite**
	+ **FG 13-1: [6]**
* **Need for the gNB to know if the feature is supported**
	+ **No: [10]**
* **Type of signaling**
	+ **Per band: [4], [11]**
	+ **Per UE: [3], [5], [6], [7], [13]**
* **Need of FR1/FR2 differentiation**
	+ **N/A: [11]**
	+ **Yes: [12]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

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| [3] | * Per UE and differentiated for FR1 and FR2.
* For component 4, the value 3 should be reserved for low cost UE.

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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}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], [16], 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}] | 13-1 | Yes | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported.FFS: split of candidate values for FR1/FR2/mixed FR1-FR2 for each component | Optional with capability signaling |

 |
| [4] | * Per band
* Component 4: Support Values: {3, 6, 12, 24, 32, 64, 128, 256}
 |
| [5] | **Proposal 4**: For FG 13-4* It is signalled per UE, with values for FR1/FR2/mixed FR1-FR2 for each component
 |
| [6] | * FG 13-4
	+ Pre-requisite: 13-1
	+ Type of signaling: Per UE
	+ Keep component 6 (max number of positioning frequency layers UE supports) within each FG and further discuss whether it is common across DL-AoD, DL-TDoA and multi-RTT or not
	+ Do not split candidate values among components
	+ Confirm set of values for each component
 |
| [7] | * Per UE
* Component 4: support to keep 3 as minimum value
 |
| [9] | * For component 4, we think that description on component 4 needs to be changed as follows: “Max number of TRPs across all positioning frequency layers ~~per UE~~.” since the “type” for this FG is still FFS. Among the possible values, we suggest that 3 needs to be added, since some UEs can support the minimum number of TRPs so that they can support DL-TDOA and Multi-RTT technique.
* For component 6, the candidate values seems enough, so we prefer removing square bracket.
 |
| [10] | * For FG13-4
	+ Need for the gNB to know should be “No”.
	+ Component 2: suggest to split with the following 2 values
		- FR1: {1, 2, 4, 8}
		- FR2: {1, 8, 16, 64}
	+ Component 3: Suggest to split with the following 4 values
		- FR1 only: minimum value should be 3, i.e, {3, 24, 128, 512}
		- FR2 only: minimum value should be 24, i.e. {24, 96, 512, 2048}
		- FR1 in mixed FR1-FR2: minimum value should be 3, i.e. {3, 24, 64, 256}
		- FR2 in mixed FR1-FR2: minimum value should be 24, i.e. {24, 96, 256, 1024}
	+ Component 5: Suggest to split with the following 2 values
		- FR1: minimum values should be 3, i.e. {3, 24, 128}
		- FR2: minimum value should be 24, i.e. {24, 96, 512}
 |
| [11] |

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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}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 = {12, 16, 24, 32, 64, 128, 256}1. Max number of DL PRS Resources per positioning frequency layer.

Values = {32, 64, 128, 256, 512, 1024} | 13-1 | Yes | N/A |  | Per band | N/A | N/A | N/A | Need for location server to know if the feature is supported.FFS: split of candidate values for FR1/FR2/mixed FR1-FR2 for each component | Optional with capability signaling |

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| [12] |

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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}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], [16], 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}] | 13-1 | Yes | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported.FFS: split of candidate values for FR1/FR2/mixed FR1-FR2 for each component | Optional with capability signaling |

 |
| [13] | In our view, the Max number of positioning frequency layers UE supports should not depend on the methods and could be moved to feature 13-1. Proposal 3 Remove component 6 (Max number of positioning frequency layers UE supports) from Feature groups 13-2, 13-3 and 13-4. Introduce Max number of positioning frequency layers UE supports as a component in Feature group 13-1. Furthermore, we support Per UE signaling for feature groups 13-2,13-3,13-4.**Proposal 4 support Per UE signaling for feature groups 13-2,13-3,13-4.** |

Based on above, following FL proposals are made.

### **FL proposal 4:**

* **The value “[3], [6], [12]” in component 4 of FG13-4 are kept, and the value “[16]” in component 4 of FG13-4 is removed**
* **The component 6 of FG13-4 is kept**
* **Type of FG13-4 is “Per UE”**
	+ **Need of FDD/TDD differentiation is “No”**
	+ **Need of FR1/FR2 differentiation is “Yes”**
* **Need for the gNB to know if the feature is supported is “No” for FG13-4**

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| 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, 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} | 13-1 | No | N/A |  | Per UE | No | Yes | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Suggest to have the following, and change FR1/FR2 differentiation to “No”.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 for FR1.

Values = {1, 2, 4, 8}1. Max number of DL PRS Resources per DL PRS Resource Set for FR2.

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 for FR1-only.

Values = {3, 24, 64, 128, 192, 256, 512, 1024, 2048}1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only. (optional)

Values = {24, 96, 192, 256, 512, 1024, 2048}1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation.

Values = {3, 24, 64, 128, 192, 256, 512, 1024, 2048}1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation.

Values = {24, 96, 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 FR1 positioning frequency layer.

Values = {3, 24, 128, 256, 512, 1024}1. Max number of DL PRS Resources per FR2 positioning frequency layer.

Values = {24, 64, 96, 128, 256, 512, 1024}1. Max number of positioning frequency layers UE supports

Values = {1, 2, 3, 4} |
| Qualcomm | * Componet 4: 3 should not be supported as a minimum value. It is too low and we risk having bad performance.
* We think it should be reported “per-band” at least for the purpose of licensed/unlicensed band differentiation and for the IODT purposes.
* The “max number of frequency layers” corresponds to the layers that are supported by the UE across all bands & FR1/FR2 & methods. In other words, the minimum capability of NR Positioning should be 1 layer across all methods and bands. For this reason, we do believe that it should be part of the 13-1
 |
| Huawei/HiSilicon2 | Small changes to the previous comment on the numbersReply to QC:* Adding small numbers will be future proof so that we do not need to introduce reduced capability UE in future LPP operation. This may result in the bad performance, but it is more like a deployment option.
* With PRS processing capability reported per band, and if UE does not support band n46, UE simply does not support UE processing capability in band n46. Resource capability reported per UE can work fine.

13-1 is reported per band, but even QC mentioned that the number of positioning frequency layer is the total number across all bands; how can it be interpreted? |
| MTK | 1. The FG is per UE. Each component may or may not have different values with FR differentiation.
2. Componenet 6 (max number of positioning frequency layers UE supports) is reported considering the following 4 scenarios:

FR1-only, FR2-only, FR1 in FR1/FR2 mixed operation, and FR2 in FR1/FR2 mixed operation.1. To QC’s concern, maybe we can add a note that this FG considering only licensed band. Positioning under unlicensed band is not in the discussion scope, isn’t it?
2. Support the values provided in HW’s comments 1,2,3 (in the first row of this table)
3. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1.

Values = {6, 24, 64, 128, 192, 256, 512}1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2:

Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}1. For component 4, we would like to keep the value 16, i.e., max number of TRPs across all positioning frequency layers per UE:

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

Values = {32, 64, 128} for FR1Values = {32, 64, 128, 256, 512, 1024} for FR2 |
| Nokia, NSB | We agree with FL proposal that FG type is per UE. It is not completely clear if there is a need for FRx differentiation in this case. |

## 2.5 FG13-5/5a

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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****(the ‘type’ definition from UE features should be based on the granularity of 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 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
 | 13-2 | No | N/A |  | [Per band] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported. | Optional with capability signalling{supported, notSupported} |

* **FG 13-5**
	+ **Pre-requisite**
		- **FG 13-2: [6]**
	+ **Type of signaling**
		- **Per band: [11]**
		- **Per UE: [4], [6], [7], [9]**
	+ **Need of FR1/FR2 differentiation**
		- **N/A: [11]**
		- **Yes: [12]**
* **FG 13-5a**
	+ **Pre-requisite**
		- **FG 13-2: [6]**
	+ **Type of signaling**
		- **Per band: [9], [11], [12]**
		- **Per UE: [4], [6]**
	+ **Need of FR1/FR2 differentiation**
		- **N/A: [11]**
		- **Yes: [12]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [4] | * FG 13-5, 13-5a
	+ Per UE
 |
| [6] | * FG 13-5, 13-5a
	+ Pre-requisite: 13-2
	+ Type of signaling: Per UE
 |
| [7] | * FG 13-5
	+ Per UE
 |
| [9] | * FG 13-5
	+ Per UE
* FG 13-5a
	+ Per band
 |
| [11] |

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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 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 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
 | 13-2 | 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 signalling{supported, notSupported} |

 |
| [12] |

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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 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
 | 13-2 | No | N/A |  | [Per band] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported. | Optional with capability signalling{supported, notSupported} |

 |

Based on above, following FL proposals are made.

### **FL proposal 5:**

* **Type of FG13-5 is “Per UE”**
	+ **Need of FDD/TDD differentiation is “No”**
	+ **Need of FR1/FR2 differentiation is “Yes”**
* **Type of FG13-5a is “Per band”**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| 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 | No | 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
 | 13-2 | 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 signalling{supported, notSupported} |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | We think it should be reported “per-band” at least for the purpose of licensed/unlicensed band differentiation and for the IODT purposes.  |
| Nokia, NSB | We agree with FL proposal that FG13-5 type is per UE. It is not completely clear if there is a need for FRx differentiation in this case. We also agree with FL proposal for type of 13-5a as “Per band”. |
|  |  |
|  |  |

## 2.6 FG13-6/6a

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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****(the ‘type’ definition from UE features should be based on the granularity of 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. [DL RSTD measurements per pair of TRPs. Values = {1, 2, 3, 4}]
2. [Support RSRP measurements. Values = {0, 1}]
 | 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
 | 13-3 | No | N/A |  | [Per band] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported. | Optional with capability signalling{supported, notSupported} |

* **FG 13-6**
	+ **Remove [RSRP] from feature group name: [3], [11]**
	+ **Components for FG13-6**
		- **Component 1**
			* **Remove the bracket: [4], [6], [9], [11]**
		- **Component 2**
			* **Remove the bracket: [4], [6], [9], [11]**
		- **Add new component**
			* **support of additional path report. Values = {0, 1, 2}: [2]**
	+ **Pre-requisite**
		- **FG 13-3: [6], [12]**
	+ **Type of signaling**
		- **Per band: [4], [11]**
		- **Per UE: [6], [9]**
	+ **Need of FR1/FR2 differentiation**
		- **N/A: [11]**
		- **Yes: [12]**
* **FG 13-6a**
	+ **Pre-requisite**
		- **FG 13-3: [6], [12]**
	+ **Type of signaling**
		- **Per band: [4], [9], [11], [12]**
		- **Per UE: [6]**
	+ **Need of FR1/FR2 differentiation**
		- **N/A: [11]**
		- **Yes: [12]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | To align with RAN2’s specification, we propose to add a component to FG 13-6 as the following.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** |
| 13. NR Positioning | 13-6 | DL PRS RSTD/[RSRP] Measurement Report for DL-TDOA | 1. [DL RSTD measurements per pair of TRPs. Values = {1, 2, 3, 4}]
2. [Support RSRP measurements. Values = {0, 1}]
3. Support of additional path report. Values = {0, 1, 2}
 | 13-3 | No |

 |
| [3] | FG 13-6: Remove [RSRP] since the FGs already has the RSRP component.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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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 RSTDMeasurement Report for DL-TDOA | 1. [DL RSTD measurements per pair of TRPs. Values = {1, 2, 3, 4}]
2. [Support RSRP measurements. Values = {0, 1}]
 | 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
 | 13-3 | No | N/A |  | [Per band] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported. | Optional with capability signalling{supported, notSupported} |

 |
| [4] | * FG 13-6
	+ Per band
	+ Support RSRP measurement
	+ Component 1 and 2: Support
* FG 13-6a
	+ Per band
 |
| [6] | * FG 13-6, 13-6a
	+ Pre-requisite: 13-3
	+ Type of signaling: Per UE
	+ For FG 13-6 (DL PRS RSTD/[RSRP] measurement report for DL-TDOA), support FG split into two components:
		- RSRP support
		- Number of RSTD measurement per DL PRS Resource Set
 |
| [9] | * FG 13-6
* For component 1, the square bracket could be removed since it is clear that the UE can report RSTD values per pair of TRPs up to 4, which can be seen in the current signal measurement information of DL-TDOA in TS 37.355.
* For component 2,
	+ In the third column, we prefer removing square bracket in “DL PRS RSTD/[RSRP] Measurement Report for DL-TDOA”. The DL PRS RSRP measurement reporting has been already supported in DL-TDOA technique.
	+ In the signal measurement information of DL-TDOA in TS 37.355, the RSRP value to be reported by UE is denoted as FFS, and it is written “value range to be decided in RAN4”, so we need to wait for RAN4 decision.
* Per UE
* FG 13-6a
* Per band
 |
| [11] | RSRP reporting for MRTT and TDOA methods should be considered an optional feature for two main reasons: * In short, usefulness of RSRP in TDOA and MRTT positioning has not been proven in any Study Item or Work Item. No company provided results on how the RSRP can be really used and what are any the potential gains.
* It was not supported at all in LTE OTDOA; adding it as a mandatory feature in NR without any study or at least without having a precedence of usefulness in LTE, is not reasonable.

***Proposal 4: Support of RSRP reporting is optional for both M-RTT and TDOA positioning. If the UE supports the feature, it can report as many RSRPs as Rx-Tx or RSTD values.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | Measurement Report for DL-TDOA | 1. DL RSTD measurements per pair of TRPs. Values = {1, 2, 3, 4}
2. Support RSRP measurements. Values = {0, 1}
 | 13-3 | 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
 | 13-3 | 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 signalling{supported, notSupported} |

 |
| [12] | * FG 13-6
	+ component 2: remove “values = {0, 1}” as this would be equivalent to disabling a component, which is not aligned to the design rules followed in defining the Rel-16 UE features. Clarify that multiple DL PRS-RSRP could be reported if multiple RSTD are supported in component 1. Replace RSRP with “DL PRS-RSRP” for clarity.

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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. [DL RSTD measurements per pair of TRPs. Values = {1, 2, 3, 4}]
2. [Support RSRP measurements. Values = {0, 1}]
 | 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
 | 13-3 | No | N/A |  | [Per band] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported. | Optional with capability signalling{supported, notSupported} |

 |

Based on above, following FL proposals are made.

### **FL proposal 6:**

* **“[/RSRP]” in FG name of FG13-6 is removed**
* **The component 1 and 2 of FG13-6 are kept**
* **Type of FG13-6 is “Per UE”**
	+ **Need of FDD/TDD differentiation is “No”**
	+ **Need of FR1/FR2 differentiation is “Yes”**
* **Type of FG13-6a is “Per band”**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 13. NR Positioning | 13-6 | DL PRS RSTD Measurement Report for DL-TDOA | 1. DL RSTD measurements per pair of TRPs. Values = {1, 2, 3, 4}
2. Support RSRP measurements. Values = {0, 1}
 | 13-3 | No | N/A |  | Per UE | No | 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
 | 13-3 | 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 signalling{supported, notSupported} |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | * We think it should be reported “per-band” at least for the purpose of licensed/unlicensed band differentiation and for the IODT purposes.
* Remove the word “RSTD” in the name of the 13-6 row.
 |
| Nokia, NSB | We agree with FL proposal that FG13-6 type is per UE. It is not completely clear if there is a need for FRx differentiation in this case. We also agree with FL proposal for type of 13-6a as “Per band”. |
|  |  |
|  |  |

## 2.7 FG13-8/8a/8b

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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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****(the ‘type’ definition from UE features should be based on the granularity of 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, 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}] |  | 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 |

* **FG 13-8**
	+ **Components**
		- **Component 3**
			* **Remove the component 3: [4]**
			* **Remove the bracket: [7], [11]**
			* **Remove the value 1: [9]**
		- **Component 4**
			* **Remove the component 4: [4], [5] (remove either component 4 or 5), [7]**
		- **Component 5**
			* **Remove the bracket: [4], [11]**
			* **Remove the component 5: [3], [5] (remove either component 4 or 5), [6]**
		- **Component 6**
			* **Remove the component 6: [4]**
			* **Remove the bracket: [11]**
		- **Confirm values for all components: [6]**
	+ **Pre-requisite**
		- **N/A: [6], [12]**
	+ **Type of signaling**
		- **Per FS: [4], [6], [11], [12]**
* **FG 13-8a**
	+ **Components**
		- **Component 2**
			* **Remove the component 2: [4]**
			* **Remove the bracket: [7], [11]**
		- **Confirm values for all components: [6]**
	+ **Pre-requisite**
		- **FG 13-8: [6], [12]**
	+ **Type of signaling**
		- **Per FS: [4], [6], [11], [12]**
* **FG 13-8b**
	+ **Components**
		- **Component 2**
			* **Remove the component 2: [4]**
			* **Remove the bracket: [7], [11]**
		- **Confirm values for all components: [6]**
	+ **Pre-requisite**
		- **FG 13-8: [6], [12]**
	+ **Type of signaling**
		- **Per FS: [4], [6], [11], [12]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| [3] | * FG 13-8
	+ Remove component 5 which is same with component 4.

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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 | 13-8 | 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 per slot.

Values = {1,2,3,4,5,6,8,10,12,14}] |  | 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 |

 |
| [4] | * FG 13-8
	+ Per FS
	+ Support to add Component 5, and remove Component 3, 4 and 6.
* FG 13-8a, 13-8b
	+ Per FS
	+ Support to remove Component 2.
 |
| [5] | **Proposal 6**: FG 13-8, component 4 is the same as component 5, suggest to remove one of them |
| [6] | * FG 13-8
	+ Pre-requisite: NA
	+ Type of signaling: Per FS
	+ Remove component#5 which is a duplication of component #4:
		- RSRP support
		- RSTD measurement per DL PRS Resource Set
	+ Confirm all values for all components in FG 13-8.
* FG 13-8a, 13-8b
	+ Pre-requisite: 13-8
	+ Type of signaling: Per FS
	+ Confirm all values for all components in FGs 13-8a/8b.
 |
| [7] | * FG 13-8
	+ Component 4 and component 5 are same. Suggest to remove Component 4.
	+ Component 3: support it and the [] shall be removed.
* FG 13-8a, 13-8b
	+ Support it and the [] shall be removed.
 |
| [9] | * FG 13-8
	+ For component 3, we do not think that 1 is necessary. In our understanding, this component means the maximum number of SRS resources considering both of SRS for MIMO and SRS for positioning, so we think the minimum value might be 2 among the possible values.
	+ For component 4/5/6, we think that the captured values on maximum number of SRS resources are enough so we do not support additional values. For the captured values, we are fine.
 |
| [10] | * For FG13-8
	+ Component 3: This is related to a Rel-15 capability counting only MIMO SRS. We would like to make sure that the value reported should be no lower than the value for periodic MIMO SRS in a slot.
	+ Component 5: It seems to be the same as Component 4.
 |
| [11] |

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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 | 13-8 | 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} |  | 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 |

 |
| [12] |

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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 | 13-8 | 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}] |  | 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 |

 |

Based on above, following FL proposals are made.

### **FL proposal 7:**

* **The component 3, 5 and 6 of FG13-8 are kept, and the component 4 of FG13-8 is removed**
* **The component 2 of FG13-8a is kept**
* **The component 2 of FG13-8b is kept**
* **Type of FG13-8/8a/8b is “Per FS”**

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| 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 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} |  | 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 |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | No need for the location server to know. Propose to remove the contents in the “Note” column. |
| Qualcomm | Location server should know.  |
| Huawei/HiSilicon | UE CA capability has nothing to do with UE CA configuration. For example, UE may report supporting number of SRS resources per band in a band combination, and there could be a lot of band combanations, but LMF has no idea what band combination is configured to the UE. There is nothing LMF can do with such a complicated UE capability reporting, majority of which are radio aspects.We are also worried on over-exposure of UE radio capability to core network as core network already has UE permanent ID. |
| MTK | Is there any information signalling from location server to gNB related to this FG? If no, then location server doesn’t need to know. |
| Nokia, NSB | It is not clear why the FGs would need to be “per FS”. Further clarification is needed. |

## 2.8 FG13-9/9a/9b/9c/9d/9e

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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****(the ‘type’ definition from UE features should be based on the granularity of 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
 | [13-1],[One of {13-2, 13-3, 13-4}], and 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 | 13-9a | 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 and [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 and 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}] | One of {13-9, 13-9a,b,c,[d]} | 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 |

* **FG 13-9**
	+ **Component description**
		- **Assume SRS and other RS are in the same band: [3]**
	+ **Pre-requisite**
		- **FG 13-1: [9]**
		- **FG 13-1, 13-8: [6]**
	+ **Need for the gNB to know if the feature is supported**
		- **Yes: [10]**
	+ **Type of signaling**
		- **Per band: [4], [6], [11], [12]**
* **FG 13-9a**
	+ **Component description**
		- **Assume SRS and other RS are in the same band: [3]**
	+ **Pre-requisite**
		- **FG 13-9d: [9]**
		- **FG 13-8 and 13-9d: [6]**
	+ **Need for the gNB to know if the feature is supported**
		- **Yes: [10]**
	+ **Type of signaling**
		- **Per band: [4], [6], [11], [12]**
* **FG 13-9b**
	+ **Component description**
		- **Assume SRS and other RS are in the same band: [3]**
	+ **Pre-requisite**
		- **N/A: [5]**
		- **FG 13-9: [6]**
	+ **Need for the gNB to know if the feature is supported**
		- **Yes: [10]**
	+ **Type of signaling**
		- **Per band: [4], [6], [11], [12]**
* **FG 13-9c**
	+ **Pre-requisite**
		- **FG 13-8: [6]**
	+ **Need for the gNB to know if the feature is supported**
		- **Yes: [10]**
	+ **Type of signaling**
		- **Per band: [4], [6], [11], [12]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| [3] | * FG13-9, FG13-9a, FG13-9b, FG13-10b
	+ should assume SRS and other RS are in the same band.
* FG13-9d
	+ For SRS transmission, pathloss RS should be configured. OLPC for SRS based on SSB from serving cell should be the basic component for SRS for positioning. So this FG should be either removed.

***Proposal 1:*** *FG 13-9d should be removed.** FG13-9e
	+ Remove component 2
	+ Suggest to rewording the component 1 into “Max number of pathloss estimates that the UE can simultaneously maintain for all the SRS resource sets for positioning across all serving cells within a band in addition to the up to four pathloss estimates that the UE maintains per serving cell for the PUSCH/PUCCH/SRS transmissions”.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | [13-1],[One of {13-2, 13-3, 13-4}], and 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 | 13-9a | 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 and [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 and 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 | 13-9e | [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 within a band 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}] | One of {13-9, 13-9a,b,c,[d]} | 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 |

 |
| [4] | * FG 13-9, 13-9a, 13-9b, 13-9c
	+ Per band
* FG 13-9d
	+ Not needed. All UEs should support SRS for positioning can do OLPC based on SSB from serving cell.
* FG 13-9e
	+ Per band
	+ Support to add Component 1 and 2.
 |
| [5] | **Proposal 7**: FG 13-9, 13-9b, if it is per band signaling, we would like to clarify that whether it means SRS and PRS are in the same band? If the answer is yes, suggest to put a note in this FG to clarify this understanding**Proposal 8**: FG 13-9b, the pre-requisite FGs doesn’t need to contain FG 13-8 (since FG 13-9 is an pre-requisite FG)**Proposal 9**: FG 13-9a, 13-9d, if it is per band signaling, we would like to clarify that whether it means SSB and PRS are in the same band? If the answer is yes, suggest to put a note in this FG to clarify this understanding**Proposal 10**: FG 13-9c, if it is per band signaling, we would like to clarify that whether it means CSI-RS and PRS are in the same band? If the answer is yes, suggest to put a note in this FG to clarify this understanding**Proposal 11**: FG 13-9e and 13-10f, it should be per UE with FR differentiation**Proposal 12**: FG 13-9d, this FG is not needed, since UE supporting SRS for positioning should all support OLPC based on SSB from serving cell |
| [6] | * FG 13-9
	+ Pre-requisite: 13-1, 13-8
	+ Type of signaling: Per band
* FG 13-9a
	+ Pre-requisite: 13-8 and 13-9d
	+ Type of signaling: Per band
* FG 13-9b
	+ Pre-requisite: 13-9
	+ Type of signaling: Per band
* FG 13-9c
	+ Pre-requisite: 13-8
	+ Type of signaling: Per band
* FG 13-9d
	+ Pre-requisite: 13-8
	+ Type of signaling: Per band
	+ In our view this FG can be either a basic FG for UEs supporting SRS for positionng i.e. supporting FG13-8. We are also open to have FG 13-9d as a pre-requisite to other FGs covering OLPC or merge it as a component for the FG 13-8.
		- The RAN1 to select one of the following options
			* Option 1. Define 13-9d as a basic FG for UEs supporting SRS for positioning (i.e. 13-8)
			* Option 2. Make it a pre-requisite for all FGs 13-9x
			* Option 3. Merge it as a component of the FG 13-8
* FG 13-9e
	+ Pre-requisite: One of {13-9, 13-9a,b,c,d}
	+ Type of signaling: Per band
	+ Regarding the FG 13-9e, we propose to change it name to “Pathloss monitoring for SRS for positioning” and are open to keep both components considering UL CA scenario and potential pathloss sharing between UL CCs of serving cell as well as to avoid configuration of all pathlosses per serving cell.
		- change name to “Pathloss monitoring for SRS for positioning”
		- keep both components
 |
| [7] | * FG 13-9d
	+ Support it and the [] shall be removed.
* FG 13-9e
	+ It shall be supported and remove all the []s.
	+ Support both components 1 and 2.
 |
| [9] | * FG 13-9
	+ For the path-loss estimation for a DL PRS resource which is transmitted from a serving/neighbour TRP/cell, we believe that at least 13-1 should be the prerequisite FG.
* FG 13-9a
	+ 13-9d is a prerequisite FG
* FG 13-9e
	+ In our side, we have some confusions on the name of this FG, so we suggest a change of this FG name as “simultaneous maintenance of path-loss estimate”
	+ In this FG, component 1 seems necessary
 |
| [10] | * We suggest to combine FG13-9c, FG13-9d, FG13-10, FG13-10a into a single basic FG, as below. The components are listed of follows, and is reported per band. The prerequisite FGs of other FGs should be updated accordingly.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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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 | 13-19 | Basic SRS for positioning | 1. Support of single SRS resource for positioning per BWP.
2. Support of OLPC for SRS for positioning based on SSB from serving cell.
3. Support of OLPC for SRS for positioning based on CSI-RS from serving cell.
4. Support of spatial relation for SRS for positioning based on SSB from the serving cell for FR2 bands
5. Support of spatial relation for SRS for positioning based on CSI-RS from the serving cell for FR2 bands
 |  | Yes | N/A |  | Per band | [N/A] | [N/A] | [N/A] | Need for the location server to know if the feature is supported. | Optional with capability signaling |

* For FG13-9
	+ Need for the gNB to know should be “Yes”.
	+ Regarding per band reporting, is it per SRS band or per PRS band?
* For FG13-9a
	+ Need for the gNB to know should be “Yes”.
	+ Regarding per band reporting, is it per SRS band or per SSB band?
* For FG13-9b
	+ Need for the gNB to know should be “Yes”.
	+ Regarding per band reporting, is it per SRS band or per PRS band?
* For FG13-9c
	+ Need for the gNB to know should be “Yes”.
	+ Suggest to have a basic FG to include this. Only need to design the signaling of the basic FG.
* For FG13-9d
	+ Need for the gNB to know should be “Yes”.
	+ Suggest to have a basic FG to include this. Only need to design the signaling of the basic FG.
* For FG13-9e
	+ Need for the gNB to know should be “Yes”.
	+ Component 1: How can component 1 be interpreted if it is reported per band? Should it be all serving cells within the reported band?

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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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 | 13-9 | 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
 | [13-1],[One of {13-2, 13-3, 13-4}], and 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 | 13-9a | 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 and [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}] | One of {13-9, 13-9a,b,c,[d]} | 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 |

 |
| [11] | SRS for positioning is another SRS which is very similar to the regular SRS-for-communications, and follows the basic principles of an SRS transmission supported in NR. Performing Open loop power control with serving cell SSB is one of such features that should be assumed as mandatory for any SRS transmission. Threefore we propose to remove the separate FG on this feature.***Proposal 5: Remove row 13-9 called “OLPC for SRS for positioning based on PRS from the serving cell”.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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
 | [13-1],[One of {13-2, 13-3, 13-4}], and 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 | 13-9a | 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 and [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 and 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 | 13-9e | 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} | One of {13-9, 13-9a,b,c} | 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 |

 |
| [12] | * FG 13-9d, 13-9e
	+ OK to confirm the FG

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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
 | [13-1],[One of {13-2, 13-3, 13-4}], and 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 | 13-9a | 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 and [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 and 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}] | One of {13-9, 13-9a,b,c,[d]} | 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 |

 |

Based on above, following FL proposals are made.

### **FL proposal 8:**

* **Add “in the same band” in component description for 13-9/9a/9b/9c**
* **Type of FG13-9/9a/9b/9c is “Per band”**
* **13-1 and 13-8 are prerequisite feature groups for FG13-9**
* **13-8 is a prerequisite feature group for FG13-9a**
* **13-9 is a prerequisite feature group for FG13-9b**
* **13-8 is a prerequisite feature group for FG13-9c**
* **Need for the gNB to know if the feature is supported is “Yes” for FG13-9/9a/9b/9c**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 in the same band
 | 13-1and 13-8 | 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 | 13-9a | OLPC for SRS for positioning based on SSB from neighbouring cells | 1. OLPC for SRS for positioning based on SSB from neighbouring cells in the same band
 | 13-8 | 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 | 13-9b | OLPC for SRS for positioning based on PRS from the neighbouring cells | 1. OLPC for SRS for positioning based on PRS from the neighbouring cells in the same band
 | 13-9 | 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 | 13-9c | 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 in the same band
 | 13-8 | 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 check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | No need for the location server to know. Propose to remove the contents in the “Note” column.Regarding restricting the operation to the same band, we are OK. |
| Qualcomm | Location server should know |
| Huawei/HiSilicon | We do not think OLPC capability is useful at LMF, as LMF only recommends spatial relation to the serving gNB.We are also worried on over-exposure of UE radio capability to core network as core network already has UE permanent ID. |
| MTK | Location server should know as in LPP the power of SSB/PRS from serving/neighbor cells may or may not be signaled to UE |

## 2.9 FG13-10/10a/10b/10c/10d/10e/[10f]

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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****(the ‘type’ definition from UE features should be based on the granularity of 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
 | 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
 | One of {13-2, 13-3, 13-4} and13-8 | 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}] | One of {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 |

* **FG 13-10**
	+ **Pre-requisite**
		- **FG 13-8: [6]**
	+ **Type of signaling**
		- **Per band: [4], [6], [11], [12]**
	+ **Need for the gNB to know if the feature is supported**
		- **Yes: [10]**
* **FG 13-10a**
	+ **Pre-requisite**
		- **FG 13-10: [6]**
	+ **Type of signaling**
		- **Per band: [4], [6], [11], [12]**
	+ **Need for the gNB to know if the feature is supported**
		- **Yes: [10]**
* **FG 13-10b**
	+ **Pre-requisite**
		- **One of {13-2, 13-3, 13-4} and 13-8: [6]**
	+ **Type of signaling**
		- **Per band: [4], [6], [11], [12]**
	+ **Need for the gNB to know if the feature is supported**
		- **Yes: [10]**
* **FG 13-10c**
	+ **Pre-requisite**
		- **FG 13-8: [6]**
	+ **Type of signaling**
		- **Per band: [4], [6], [11], [12]**
	+ **Need for the gNB to know if the feature is supported**
		- **Yes: [10]**
* **FG 13-10d**
	+ **Pre-requisite**
		- **FG 13-10: [6]**
	+ **Type of signaling**
		- **Per band: [4], [6], [11], [12]**
	+ **Need for the gNB to know if the feature is supported**
		- **Yes: [10]**
* **FG 13-10e**
	+ **Pre-requisite**
		- **FG 13-10b: [6]**
	+ **Type of signaling**
		- **Per band: [4], [6], [11], [12]**
	+ **Need for the gNB to know if the feature is supported**
		- **Yes: [10]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [3] | * FG13-10f
	+ Remove component 2
	+ Suggest to rewording the component 1 into “Max Number of maintained spatial relations for all the SRS resource sets for positioning across all serving cells within a band in addition to the spatial relations maintained spatial relations per serving cell for the PUSCH/PUCCH/SRS transmissions”.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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. [Component 1: Max Number of maintained spatial relations for all the SRS resource sets for positioning across all serving cells within a band 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}] | One of {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 |

 |
| [4] | * FG 13-10, 13-10a, 13-10b, 13-10c, 13-10d, 13-10e
	+ Per band
* FG 13-10f
	+ Per band
	+ Support to add Component 1 and 2.
 |
| [5] | **Proposal 7**: FG 13-9, 13-9b, if it is per band signaling, we would like to clarify that whether it means SRS and PRS are in the same band? If the answer is yes, suggest to put a note in this FG to clarify this understanding**Proposal 8**: FG 13-9b, the pre-requisite FGs doesn’t need to contain FG 13-8 (since FG 13-9 is an pre-requisite FG)**Proposal 9**: FG 13-9a, 13-9d, if it is per band signaling, we would like to clarify that whether it means SSB and PRS are in the same band? If the answer is yes, suggest to put a note in this FG to clarify this understanding**Proposal 10**: FG 13-9c, if it is per band signaling, we would like to clarify that whether it means CSI-RS and PRS are in the same band? If the answer is yes, suggest to put a note in this FG to clarify this understandingThe argument in proposal 7,8,9 can also apply to FG 13-10, 13-10a, 13-10b, 13-10d, 13-10e.**Proposal 11**: FG 13-9e and 13-10f, it should be per UE with FR differentiation |
| [6] | * FG 13-10
	+ Pre-requisite: 13-8
	+ Type of signaling: Per band
* FG 13-10a
	+ Pre-requisite: 13-10
	+ Type of signaling: Per band
* FG 13-10b
	+ Pre-requisite: One of {13-2, 13-3, 13-4} and 13-8
	+ Type of signaling: Per band
* FG 13-10c
	+ Pre-requisite: 13-8
	+ Type of signaling: Per band
* FG 13-10d
	+ Pre-requisite: 13-10
	+ Type of signaling: Per band
* FG 13-10e
	+ Pre-requisite: 13-10b
	+ Type of signaling: Per band
* FG 13-10f
	+ Support
	+ Pre-requisite: One of {13-10, 13-10a, b, d, e}
	+ Type of signaling: Per band
	+ For spatial relation maintenance, we think component #1 only is sufficient and we assume that number of maintaned spatial relations is defined across total number of SSB and DL PRS.
		- Keep only component #1
		- Clarify that max number of spatial relations is defined in total i.e. across SSBs and DL PRSs
 |
| [7] | We support to include it and suggest to remove the []. Furthermore, we prefer to include two more components to specify the max number of spatial relations based on reference signal (SSB or DL PRS resource) from a neighbor cell. The reason for that is the UE behavior for tracking reference signals from serving cell and from neighbor cells for spatial relation information are different. Proposal 3: Support FG 13-10f and add two new components to FG 13-10f:* Component 3: Max Number of maintained spatial relations based on SSB from neighboring cells for all the SRS resource sets for positioning across all serving cells
* Component 4: Max Number of maintained spatial relations based on DL PRS from neighboring cells for all the SRS resource sets for positioning across all serving cells.
 |
| [9] | * FG 13-10f
	+ We are not sure that this FG would be necessary, and this needs to be discussed further. In our understanding, in case of path-loss reference RS, the UE needs to estimate in the long-terms sense to obtain accurate RSRP measurements to accurately compensate path-loss and the path-loss would be determined considering multiple measurements obtained for a long time, so maintaining many path-loss reference RSs could result in high overhead at the UE and hence, different UE capability needs to be defined. However, spatial relation information seems different.
	+ At this time, we would like to minor change of component 1 and 2. It is reasonable to remove “sets” from “Max Number of maintained spatial relations for all the SRS resources ~~sets~~ for positioning across all serving cells…”, since spatial relation information is configured for resource level (not resource set level).
 |
| [10] | * We suggest to combine FG13-9c, FG13-9d, FG13-10, FG13-10a into a single basic FG, as in section 2.15. The components are listed of follows, and is reported per band. The prerequisite FGs of other FGs should be updated accordingly.
	+ Support of single SRS resource for positioning per BWP.
	+ Support of OLPC for SRS for positioning based on SSB from serving cell.
	+ Support of OLPC for SRS for positioning based on CSI-RS from serving cell.
	+ Support of spatial relation for SRS for positioning based on SSB from the serving cell for FR2 bands
	+ Support of spatial relation for SRS for positioning based on CSI-RS from the serving cell for FR2 bands
* For FG13-10
	+ Need for the gNB to know should be “Yes”.
	+ Suggest to have a basic FG to include this, and it is for FR2. Only need to design the signaling of the basic FG.
* For FG13-10a
	+ Need for the gNB to know should be “Yes”.
	+ Suggest to have a basic FG to include this, and it is for FR2. Only need to design the signaling of the basic FG.
* For FG13-10b
	+ Need for the gNB to know should be “Yes”.
	+ Regarding per band reporting, is it per SRS band or per PRS band?
* For FG13-10c
	+ Need for the gNB to know should be “Yes”.
* For FG13-10d
	+ Need for the gNB to know should be “Yes”.
	+ Regarding per band reporting, is it per SRS band or per SSB band?
* For FG13-10e
	+ Need for the gNB to know should be “Yes”.
	+ Regarding per band reporting, is it per SRS band or per PRS band?
* For FG13-10f
	+ Need for the gNB to know should be “Yes”.
	+ Component 1: How can component 1 be interpreted if it is reported per band? Should it be all serving cells within the reported band?

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 13. NR Positioning | 13-17 | AP-SRS with carrier switching | 1. Support of AP-SRS for positioning with carrier switching triggered by DCI format 2\_3.
 | 13-8 | Yes | N/A |  | Per UE | [N/A] | [N/A] | [N/A] |  | Optional with capability signaling |

 |
| [11] | ***Proposal 6: Introduce a FG bit for Aperiodic SRS for positioning triggered with DCI format 2\_3. This is reported per band.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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
 | 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
 | One of {13-2, 13-3, 13-4} and13-8 | 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. 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} | One of {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 | 13-10g | AP-SRS with carrier switching | 1. Support of AP-SRS for positioning with carrier switching triggered by DCI format 2\_3.
 | 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 |

 |
| [12] | * FG 13-10f
	+ OK to confirm the FG
* General comment: FGs referring to “SRS for positioning” should refer instead to SRS-PosResource for clarity. This includes 13-9, 13-9a/b/c/d, 13-10, 13-10a/b/c/d/e.

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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 | 13-10 | 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
 | One of {13-2, 13-3, 13-4} and13-8 | 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}] | One of {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 |

 |

Based on above, following FL proposals are made.

### **FL proposal 9:**

* **Add “in the same band” in component description for 13-10/10a/10b/10c/10d/10e**
* **Type of FG13-10/10a/10b/10c/10d/10e is “Per band”**
* **Need for the gNB to know if the feature is supported is “Yes” for FG13-10/10a/10b/10c/10d/10e**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 in the same band
 | 13-8 | Yes | 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 in the same band
 | 13-10 | Yes | 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 in the same band
 | One of {13-2, 13-3, 13-4} and13-8 | Yes | 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 in the same band
 | 13-8, | Yes | 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 in the same band
 | 13-10 | Yes | 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 in the same band
 | 13-10b | Yes | 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 |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | No need for the location server to know all of them. Propose to remove the contents in the “Note” column for 13-10, 13-10a, 13-10b, 13-10c.It should have the same restriction as “in the same band” in FG13-9 series. |
| Qualcomm | Add the “in the same band” as it was done in the FG 13-9 UE features series. In other words, we don’t see the need for inter-band QCL spatial relation. Location server should know |
| Huawei/HiSilicon2 | We only see necessity of spatial relation capability w.r.t. SSB/PRS from neighbouring gNB as it may help LMF provide spatial relation recommendation to the serving gNB in order to assist serving gNB to configure SRS with spatial relation.We are also worried on over-exposure of UE radio capability to core network as core network already has UE permanent ID. |
| MTK | * Support QC’s view that “in the same band” should be added as it was done in the FG 13-9 UE features series”
* Is there any information signalling from location server to gNB related to this FG? If no, then location server doesn’t need to know
 |
| Moderator (NTT DOCOMO) | The FL proposal is updated as below according to feedbacks so far.* **Add “in the same band” in component description for 13-10/10a/10b/10c/10d/10e**
 |
|  |  |

## 2.10 FG13-11a/[11]

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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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****(the ‘type’ definition from UE features should be based on the granularity of 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 | 13-11a | Inter-frequency measurement for Multi-RTT | 1. Inter-frequency measurement for Multi-RTT
 | 13-4 and 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]1. [Support RSRP measurements. Values = {0, 1}]
 | 13-4 and 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 |

* **FG 13-11a**
	+ **Component 1**
		- **Add a note as follows: [10]**
			* **Note: The UE Rx – Tx time difference measurements for a single SRS can be associated with DL PRS resource/resource sets can be in different positioning frequency layers**
	+ **Component**
		- **The feature of UE reporting multiple Rx-Tx, each one on PRS from different frequency layers, should be included inside the Inter-frequency M-RTT FG (13-11a).: [11]**
	+ **Pre-requisite**
		- **FG 13-4, 13-8: [6]**
	+ **Need for the gNB to know if the feature is supported**
		- **No: [10]**
	+ **Type of signaling**
		- **Per band: [11]**
		- **Per UE: [4], [6]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| [2] | To align with RAN2’s specification, we propose to add a component to FG 13-11 as the following.

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| --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** |
| 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 layers1. Support of additional path report. Values = {0, 1, 2}
 | 13-4 and 13-8 | No |

 |
| [4] | * FG 13-11a
	+ Per UE
* FG 13-11
	+ Per UE
	+ Support to add Component 2.
 |
| [6] | * FG 13-11a
	+ Pre-requisite: 13-4 and 13-8
	+ Type of signaling: Per UE
* FG 13-11
	+ Support
	+ Pre-requisite: 13-4 and 13-8
	+ Type of signaling: Per UE
	+ Support FG split into two components:
		- RSRP support
		- UE Rx-Tx measurement per DL PRS Resource Set
 |
| [9] | * FG 13-11
	+ In principle, we think that this FG is necessary.
 |
| [10] | * For FG13-11
	+ Need for the gNB to know should be “No”.
	+ Component 1: We suggest to remove the note.
* For FG13-11a
	+ Need for the gNB to know should be “No”.
	+ Why is it reported per UE while for DL-AoD and DL-TDOA are per band?
	+ Component 1: We suggest to add the following note:
		- Note: The UE Rx – Tx time difference measurements for a single SRS can be associated with DL PRS resource/resource sets can be in different positioning frequency layers.

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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 | [13-11] | [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]1. [Support RSRP measurements. Values = {0, 1}]
 | 13-4 and 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 | 13-11a | Inter-frequency measurement for Multi-RTT | 1. Inter-frequency measurement for Multi-RTT
 | 13-4 and 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 |

 |
| [11] | RSRP reporting for MRTT and TDOA methods should be considered an optional feature for two main reasons: * In short, usefulness of RSRP in TDOA and MRTT positioning has not been proven in any Study Item or Work Item. No company provided results on how the RSRP can be really used and what are any the potential gains.
* It was not supported at all in LTE OTDOA; adding it as a mandatory feature in NR without any study or at least without having a precedence of usefulness in LTE, is not reasonable.

***Proposal 4: Support of RSRP reporting is optional for both M-RTT and TDOA positioning. If the UE supports the feature, it can report as many RSRPs as Rx-Tx or RSTD values.***The following has been agreed and has been endorsed in the 38.214:

|  |
| --- |
| *The UE may be configured to measure and report, subject to UE capability, up to 4 UE Rx-Tx time difference measurements corresponding to a single configured SRS resource or resource set for positioning. Each measurement corresponds to a single received DL PRS resource or resource set which can be in different positioning frequency layers.* |

***Proposal 7: The feature of UE reporting multiple Rx-Tx, each one on PRS from different frequency layers, should be included inside the Inter-frequency M-RTT FG (13-11a).***

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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****(the ‘type’ definition from UE features should be based on the granularity of 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 | 13-11a | Inter-frequency measurement for Multi-RTT | 1. Inter-frequency measurement for Multi-RTT* The DL PRS resource/resource sets can be in different positioning frequency layers
* PRS and SRS used for the measurements are in a different band.
 | 13-4 and 13-8 | 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 | 13-11 | 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.
	1. PRS and SRS used for the measurements are in the same band.
2. Support RSRP measurements. Values = {0, 1}
 | 13-4 and 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 |

 |
| [12] | * FG 13-11
	+ OK to confirm the FG
	+ Component 2: remove “values = {0, 1}” as this would be equivalent to disabling a component, which is not aligned to the design rules followed in defining the Rel-16 UE features. Clarify that multiple DL PRS-RSRP could be reported if multiple UE Rx-Tx are supported in component 1. Replace RSRP with “DL PRS-RSRP” for clarity.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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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 | 13-11a | Inter-frequency measurement for Multi-RTT | 1. Inter-frequency measurement for Multi-RTT
 | 13-4 and 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]1. [Support RSRP measurements. Values = {0, 1}]
 | 13-4 and 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 |

 |

Based on above, following FL proposals are made.

### **FL proposal 10:**

* **Add “The DL PRS resource/resource sets can be in different positioning frequency layers” and “PRS and SRS used for the measurements are in a different band” in component description of FG13-11a**
* **13-4 and 13-8 are prerequisite feature groups for FG13-11a**
* **Type of FG13-11a is “Per UE”**
	+ **Need of FDD/TDD differentiation is “No”**
	+ **Need of FR1/FR2 differentiation is “Yes”**
* **Need for the gNB to know if the feature is supported is “No” for FG13-11a**

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| 13. NR Positioning | 13-11a | Inter-frequency measurement for Multi-RTT | 1. Inter-frequency measurement for Multi-RTT
* The DL PRS resource/resource sets can be in different positioning frequency layers
* PRS and SRS used for the measurements are in a different band.
 | 13-4 and 13-8 | No | N/A |  | Per UE | No | Yes | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | * We think it should be reported “per-band” at least for the purpose of licensed/unlicensed band differentiation and for the IODT purposes. PRS and SRS need to be in bands for which the UE has reported it supports this feature.
* Clarify that for 13-11, “PRS and SRS used for the measurements are in the same band.”
 |
| MTK | To QC’s comment on FG 13-11, don’t understand why “PRS and SRS used for the measurements are in the same band” is needed. Suggest not to add this constraint. |

## FG13-13

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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****(the ‘type’ definition from UE features should be based on the granularity of 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 | 13-13 | 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 and 13-3 | 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 |

* **FG 13-13**
	+ **Pre-requisite**
		- **FG 13-2 and 13-3: [6]**
	+ **Type of signaling**
		- **Per band: [4], [6], [11], [12]**
	+ **Need of FR1/FR2 differentiation**
		- **N/A: [11]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [4] | * FG 13-13
	+ Per band
 |
| [6] | * FG 13-13
	+ Pre-requisite: 13-2 and 13-3
	+ Type of signaling: Per band
 |
| [11] |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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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 | 13-13 | 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 and 13-3 | 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 |

 |
| [12] |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | 13-13 | 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 and 13-3 | 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 |

 |

Based on above, following FL proposals are made.

### **FL proposal 11:**

* **Type of FG13-13 is “Per band”**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 and 13-3 | 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 check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| Nokia, NSB | The FG type should be “Per UE” as this relates to baseband processing capability and not related to a particular band.  |
|  |  |
|  |  |
|  |  |

## 2.12 FG13-14

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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****(the ‘type’ definition from UE features should be based on the granularity of 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 | 13-14 | 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 and 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 |

* **FG 13-14**
	+ **Pre-requisite**
		- **FG 13-2, 13-4, 13-8: [6]**
	+ **Type of signaling**
		- **Per band: [4], [6], [11], [12]**
	+ **Need of FR1/FR2 differentiation**
		- **N/A: [11]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [4] | * FG 13-14
	+ Per band
 |
| [6] | * FG 13-14
	+ Pre-requisite: 13-2, 13-4, 13-8
	+ Type of signaling: Per band
 |
| [11] |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | 13-14 | 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 and 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 |

 |
| [12] |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | 13-14 | 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 and 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 |

 |

Based on above, following FL proposals are made.

### **FL proposal 12:**

* **Type of FG13-14 is “Per band”**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 and 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 |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| Nokia, NSB | The FG type should be “Per UE” as this relates to baseband processing capability and not related to a particular band.  |
|  |  |
|  |  |
|  |  |

## 2.13 already agreed new FGs

* **Simultaneous SRS transmission: [2], [6], [7], [10]**
	+ **New FG: Simultaneous SRS transmission for intra-band CA is introduced**
	+ **New FG: Simultaneous SRS transmission for inter-band CA in introduced**

Above proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | During [100b-e-NR-Pos-03] email discussion, there were agreements related to UE capability for SRS for positioning. Two new UE capabilities were agreed for SRS for positioning. We propose to capture them as the following FG.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** |
| 13. NR Positioning | 13-x | Simultaneous SRS transmission for intra-band CA | 1. The number of SRS resources for positioning on a symbol for intra-band CA.

Values: {1,2} | 13-8 | Yes |
| 13. NR Positioning | 13-y | Simultaneous SRS transmission for inter-band CA | 1. The number of simultaneously transmitted SRS resources for positioning for inter-band CA.

Values: {1,2} | 13-8 | Yes |

 |
| [6] | At the previous RAN1 WG meeting (RAN1#100bis-E), the following agreements were made:

|  |
| --- |
| Agreement:* Introduce a new UE capability for the number of SRS resources for positioning on a symbol for intra-band CA
	+ FFS: Capability for simultaneous SRS transmission across bands for inter-band CA
	+ Continue discussion on capability for intra-band/inter-band CA, including potential TP to 38.214 to reflect the new capability.

Agreement:* A new UE capability is introduced for the number of simultaneous transmissions of SRS resources for positioning for inter-band CA, where the SRS resources are on different CCs.
 |

The latest baseline UE feature list for NR positioning does not reflect this agreement and therefore we propose the following changes:* + **Introduce the following additional feature groups:**
		- **Simultaneous transmission of SRS for positioning for intra-band CA**
			* **Component: Number of SRS for positioning resources for simultaneous transmission on a symbol for intra-band CA case (Values: {1, 2, …, [X]})**
		- **Simultaneous transmission of SRS for positioning for inter-band CA**
			* **Component: Number of SRS for positioning resources for simultaneous transmission on a symbol for inter-band CA case (Values: {1,2, …, [X]})**

|  |  |  |  |
| --- | --- | --- | --- |
| **FG** | **FG Name** | **Pre-requisite** | **Type of signaling** |
| 13-15 | Simultaneous transmission of SRS for positioning for intra-band CA | 13-8 | Per band |
| 13-16 | Simultaneous transmission of SRS for positioning for inter-band CA | 13-8 | [Per band combination] |

 |
| [7] | Regarding whether to define “Support of simultaneous processing of LTE PRS and NR PRS”, LTE PRS design and NR PRS design are quite different and provide different level of positioning accuracy. In this regard, we should not support simultaneous processing of LTE PRS and NR PRS.***Proposal 2****: Simultaneous processing of LTE PRS and NR PRS is not supported.*A max number of simultaneous transmissions of SRS for positioning on a symbol should be defined based on processing capability and max comb-size. In addition, if a max number is defined per symbol, there is no need to define a max number per slot.***Proposal 3****: A max number of simultaneous transmissions of SRS for positioning on a symbol should be defined based on processing capability and max comb-size and there is no need to define a max number per slot.* |
| [10] | * Based on RAN1 agreement, the following new FGs should be introduced.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | 13-15 | Simultaneous SRS transmission for intra-band CA | 1. The number of SRS resources for positioning on a symbol for intra-band CA.

Values: {1,2} | 13-8 | Yes | N/A |  | Per band | [N/A] | [N/A] | [N/A] |  | Optional with capability signaling |
| 13. NR Positioning | 13-16 | Simultaneous SRS transmission for inter-band CA | 1. The number of simultaneously transmitted SRS resources for positioning for inter-band CA.
 | 13-8 | Yes | N/A |  | [Per band combination or per FS] | [N/A] | [N/A] | [N/A] |  | Optional with capability signaling |

* In addition, we suggest to have the following FG.
	+ If FG13-18 is not supported, we would like to see conclusion that UE is not expected to support parallel processing of LTE PRS and NR PRS.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | 13-18 | Parallel LTE/NR PRS processing | 1. Support of parallel LTE PRS and NR PRS processing
 | 13-1 | Yes | N/A |  | Per UE | [N/A] | [N/A] | [N/A] |  | Optional with capability signaling |

 |

Based on above, following FL proposals are made.

### **FL proposal 13:**

* **For new FG 13-15 for “Simultaneous SRS transmission for intra-band CA”**
	+ **Candidate values of the number of SRS resources for positioning on a symbol for intra-band CA are {1, 2}**
	+ **13-8 is prerequisite feature group for FG13-15**
	+ **Type of FG13-15 is “Per band”**
	+ **FG13-15 is “Optional with capability signaling”**
* **For new FG 13-15a for “Simultaneous SRS transmission for inter-band CA”**
	+ **Candidate values of the number of SRS resources for positioning on a symbol for inter-band CA are {1, 2}**
	+ **13-8 is prerequisite feature group for FG13-15a**
	+ **Type of FG13-15a is “Per BC”**
	+ **FG13-15a is “Optional with capability signaling”**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 13. NR Positioning | 13-15 | Simultaneous SRS transmission for intra-band CA | 1. The number of SRS resources for positioning on a symbol for intra-band CA.

Values: {1,2} | 13-8 | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling |
| 13. NR Positioning | 13-15a | Simultaneous SRS transmission for inter-band CA | 1. The number of simultaneously transmitted SRS resources for positioning for inter-band CA.

Values: {1,2} | 13-8 | Yes | N/A |  | Per BC | N/A | N/A | N/A |  | Optional with capability signaling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | Add: “Need for location server to know if the feature is supported.” |
| Huawei/HiSilicon | UE CA capability has nothing to do with UE CA configuration. For example, UE may report supporting number of SRS resources per band in a band combination, and there could be a lot of band combanations, but LMF has no idea what band combination is configured to the UE. There is nothing LMF can do with such a complicated UE capability reporting, majority of which are radio aspects.We are also worried on over-exposure of UE radio capability to core network as core network already has UE permanent ID. |
| MTK | Is there any information signalling from location server to gNB related to this FG? If no, then location server doesn’t need to know. |
|  |  |

## 2.14 Others

* **Whether the “[per UE]” features in the NR Positioning RAN1 feature List are convered to “per band”: [11]**
* **Clarification to common understanding**
	+ **“Need for the gNB to know if the feature is supported” column: [10]**
	+ **In case a UE does not report the corresponding capability, whether value 0 is assumed or not: [10]**
* **FGs referring**
	+ **In FGs 13-9, 13-9a/b/c/d, 13-10 and 13-10a/b/c/d/e, “SRS for positioning” should refer instead to SRS-PosResource for clarity: [12]**

Above proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| [10] | * The rapporteur clarified in the comment that

|  |  |
| --- | --- |
| Moderator (NTT DOCOMO) | * For “Need for the gNB to know if the feature is supported” column, is it correct understanding that “yes” here means both gNB and LMF need to know while “no” here means only LMF needs to know but gNB doesn’t? Assuming so, yes/no descriptions are changed to original.
 |

We also observed that the column “Note” unanimously contains the following sentence

|  |
| --- |
| Need for location server to know if the feature is supported. |

In general, we are OK that gNB means literally gNB, which makes all DL-PRS and E-CID features “no need for gNB to know”. However, we would like to clarify that “Need for location server to know if the feature is supported” does not imply that UE should report the feature to the location server, and detailed signaling should be discussed in RAN2. For example, some capability needs gNB to know, and UE reports this to the gNB; there may be no need for UE to report it again to the location server.* We noticed value 0 is not present in some components, e.g. FG13-8a, FG13-8b, FG13-9e, and we suggest to clarify that 0 is assumed if UE does not report the corresponding capability.
 |
| [11] | There has been some debate whether some rows should be defined per band or per UE. We believe that such discussion just creates confusion and results into time-consuming debates that are unnecessary. In short, all rows that are being tagged in the latest list with [per UE] should be reported per band considering at least the following argument: There is no differentiation between licensed and unlicensed bands if a UE is reported “per UE”. Considering the different commercialization timelines and product needs, we can avoid debating whether a feature is applicable to licensed or unlicensed operation, by just making the “[per UE]” FGs to be “per band”. Such bits are important in IODTs and in product roadmap planning since it would help organize cross-company product discussions and IODT trials. There is some concern that if we make certain features to be “per band”, for example, “Number of PRS resources across all layers”, this would mean that a UE can be configured withich such a maximum for each band separately. This is not true, and we are totally fine to clarify it. Actually, this is also true even the feature is reported per UE with FR differentiation: If the UE reports different maximums, and it gets 2 layers across FR1/FR2, then what would be the maximum? This discussion should be done either way, independent of whether a feature is “per UE with FR differentation” or “per band”. So, for such cases, a generic rule that has been applied before, can be applicable also here is the following:* For a UE supporting different values between an FR1 band and FR2 band, if the UE is configured within FR1 (FR2) band only, then the reported value for the FR1 (FR2) band value is used, otherwise the minimum between the FR1 band and FR2 band values is assumed. Similar understanding for the case of bands within FR.
* For specific scenarios, if needed in some special cases, we can discuss whether a separate reporting is needed when the UE is configured with both an FR1 band and an FR2 band.

***Proposal 1: Convert the “[per UE]” features in the NR Positioning RAN1 feature List to “per band”.*** |
| [12] | FGs referring to “SRS for positioning” should refer instead to SRS-PosResource for clarity. This includes 13-9, 13-9a/b/c/d, 13-10, 13-10a/b/c/d/e. |

Based on above, following FL proposals are made.

### **FL proposal 14:**

* **The note “Need for location server to know if the feature is supported” is removed for SRS related capabilities except for 13-10d and 13-11e.**

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

 Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | As we commented, we suggest to keep almost all SRS related capability only reported to gNB, and not to LMF. Perhaps FG13-10d, and FG13-11e are OK for LMF to know as the spatial relation recommendation by the LMF to the serving gNB could utilize the capability. Other capability exposure to LMF can be found in our RAN2 contribution as follows and we sugget to leave RAN2 to discuss.R2-2005109 Discussion on the SRS UE capability in LPP Huawei, HiSilicon discussion Rel-16 NR\_pos-Core |
| Moderator (NTT DOCOMO) | New FL proposal 14 is added based on the feedback. |
|  |  |
|  |  |

1. Conclusion

**FL proposal 1:**

* **FFS text in components of FG13-1 is removed**
* **Notes for component 3 of FG13-1 is moved to Note column**
* **Add 48 as candidate value of component 4 of FG13-1 and other values in brackets are removed**
* **Change “X%” to “30%” for FG13-1 (depending on [101-e-NR-Pos-01])**

**FL proposal 2:**

* **The value “[1]” in component 2 of FG13-2 is removed**
* **The value “[3]” in component 4 of FG13-2 is kept, and the value “[16]” in component 4 of FG13-2 is removed**
* **The component 6 of FG13-2 is kept**
* **Type of FG13-2 is “Per UE”**
	+ **Need of FDD/TDD differentiation is “No”**
	+ **Need of FR1/FR2 differentiation is “Yes”**

**FL proposal 3:**

* **The value “[3]” in component 4 of FG13-3 is kept, and the value “[16]” in component 4 of FG13-3 is removed**
* **The component 6 of FG13-3 is kept**
* **Type of FG13-3 is “Per UE”**
	+ **Need of FDD/TDD differentiation is “No”**
	+ **Need of FR1/FR2 differentiation is “Yes”**

**FL proposal 4:**

* **The value “[3], [6], [12]” in component 4 of FG13-4 are kept, and the value “[16]” in component 4 of FG13-4 is removed**
* **The component 6 of FG13-4 is kept**
* **Type of FG13-4 is “Per UE”**
	+ **Need of FDD/TDD differentiation is “No”**
	+ **Need of FR1/FR2 differentiation is “Yes”**
* **Need for the gNB to know if the feature is supported is “No” for FG13-4**

**FL proposal 5:**

* **Type of FG13-5 is “Per UE”**
	+ **Need of FDD/TDD differentiation is “No”**
	+ **Need of FR1/FR2 differentiation is “Yes”**
* **Type of FG13-5a is “Per band”**

**FL proposal 6:**

* **“[/RSRP]” in FG name of FG13-6 is removed**
* **The component 1 and 2 of FG13-6 are kept**
* **Type of FG13-6 is “Per UE”**
	+ **Need of FDD/TDD differentiation is “No”**
	+ **Need of FR1/FR2 differentiation is “Yes”**
* **Type of FG13-6a is “Per band”**

**FL proposal 7:**

* **The component 3, 5 and 6 of FG13-8 are kept, and the component 4 of FG13-8 is removed**
* **The component 2 of FG13-8a is kept**
* **The component 2 of FG13-8b is kept**
* **Type of FG13-8/8a/8b is “Per FS”**

**FL proposal 8:**

* **Add “in the same band” in component description for 13-9/9a/9b/9c**
* **Type of FG13-9/9a/9b/9c is “Per band”**
* **13-1 and 13-8 are prerequisite feature groups for FG13-9**
* **13-8 is a prerequisite feature group for FG13-9a**
* **13-9 is a prerequisite feature group for FG13-9b**
* **13-8 is a prerequisite feature group for FG13-9c**
* **Need for the gNB to know if the feature is supported is “Yes” for FG13-9/9a/9b/9c**

**FL proposal 9:**

* **Type of FG13-10/10a/10b/10c/10d/10e is “Per band”**
* **Need for the gNB to know if the feature is supported is “Yes” for FG13-10/10a/10b/10c/10d/10e**

**FL proposal 10:**

* **Add “The DL PRS resource/resource sets can be in different positioning frequency layers” and “PRS and SRS used for the measurements are in a different band” in component description of FG13-11a**
* **13-4 and 13-8 are prerequisite feature groups for FG13-11a**
* **Type of FG13-11a is “Per UE”**
	+ **Need of FDD/TDD differentiation is “No”**
	+ **Need of FR1/FR2 differentiation is “Yes”**
* **Need for the gNB to know if the feature is supported is “No” for FG13-11a**

**FL proposal 11:**

* **Type of FG13-13 is “Per band”**

**FL proposal 12:**

* **Type of FG13-14 is “Per band”**

**FL proposal 13:**

* **For new FG 13-15 for “Simultaneous SRS transmission for intra-band CA”**
	+ **Candidate values of the number of SRS resources for positioning on a symbol for intra-band CA are {1, 2}**
	+ **13-8 is prerequisite feature group for FG13-15**
	+ **Type of FG13-15 is “Per band”**
	+ **FG13-15 is “Optional with capability signaling”**
* **For new FG 13-15a for “Simultaneous SRS transmission for inter-band CA”**
	+ **Candidate values of the number of SRS resources for positioning on a symbol for inter-band CA are {1, 2}**
	+ **13-8 is prerequisite feature group for FG13-15a**
	+ **Type of FG13-15a is “Per BC”**
	+ **FG13-15a is “Optional with capability signaling”**

**FL proposal 14:**

* **The note “Need for location server to know if the feature is supported” is removed for SRS related capabilities except for 13-10d and 13-11e.**

Reference

[1] R1-2003201 Summary on email discussion [100b-e-NR-UEFeatures-Remaining] NR positioning Moderator (NTT DOCOMO, INC.)

[2] R1-2003421 Discussion on UE features for NR positioning vivo

[3] R1-2003477 NR positioning UE features ZTE

[4] R1-2003609 Discussion of UE features for NR positioning CATT

[5] R1-2003693 Views on Rel-16 UE features for NR positioning MediaTek Inc.

[6] R1-2003758 On UE features for NR positioning Intel Corporation

[7] R1-2003899 UE features for NR positioning Samsung

[8] R1-2004060 Discussion on UE features for NR Positioning OPPO

[9] R1-2004139 Discussion on UE features for NR positioning LG Electronics

[10] R1-2004154 Rel-16 UE features for NR positioning Huawei, HiSilicon

[11] R1-2004483 Discussion on NR Positioning UE features Qualcomm Incorporated

[12] R1-2004566 On UE features for NR Positioning Nokia, Nokia Shanghai Bell

[13] R1-2004648 View on UE features for NR positioning Ericsson

Appendix: latest version of UE features list for Positioning [1]

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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, [6], 8, 12, 16, [24], 32, [48], 64} for each SCS: 15kHz, 30kHz, 60kHz
	2. FR2 bands: {1, 2, 4, [6], 8, 12, 16, [24], 32, [48], 64} for each SCS: 60kHz, 120kHz

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, [16], 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}] | 13-1 | No | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported.FFS: split of candidate values for FR1/FR2/mixed FR1-FR2 for each component | 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, [16], 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}] | 13-1 | No | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported.FFS: split of candidate values for FR1/FR2/mixed FR1-FR2 for each component | 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, 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], [16], 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}] | 13-1 | Yes | N/A |  | [Per UE] | N/A | [Yes] | N/A | Need for location server to know if the feature is supported.FFS: split of candidate values for FR1/FR2/mixed FR1-FR2 for each component | 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
 | 13-2 | No | N/A |  | [Per band] | 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. [DL RSTD measurements per pair of TRPs. Values = {1, 2, 3, 4}]
2. [Support RSRP measurements. Values = {0, 1}]
 | 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
 | 13-3 | No | N/A |  | [Per band] | 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]
2. [Support of reuse SSB measurement from RRM for receiving PRS]

Note: Refers to Type-C for FR1 and Type-C & Type-D support for FR2 | 13-1 | No | N/A |  | [Per band] | 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 band] | 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}] |  | 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
 | [13-1],[One of {13-2, 13-3, 13-4}], and 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 | 13-9a | 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 and [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 and 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}] | One of {13-9, 13-9a,b,c,[d]} | 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
 | 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
 | One of {13-2, 13-3, 13-4} and13-8 | 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}] | One of {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 and 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]1. [Support RSRP measurements. Values = {0, 1}]
 | 13-4 and 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] | [N R 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 and 13-3 | 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 | 13-14 | 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 and 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 |