**3GPP TSG RAN WG1 #101 R1-2004822**

**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.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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 | |
| [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:   |  | | --- | | 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. |
| [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.***      |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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 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 | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| [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 | 13-1 | 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] | 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:   |  | | --- | | 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.

**Updated 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])**
* **Need for the gNB to know if the feature is supported is “No” for FG13-1**

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| 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 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% |  | No | 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 UE  b) UE is not expected to support DL PRS bandwidth that exceeds the reported DL PRS bandwidth value  c) 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 configuration  e) 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 |
| Moderator (NTT DOCOMO) | Based on feedbacks, Need for gNB to know is changed to No.  Further discussion seems necessary on additional values for component 3/4 and additional component of “max number of positioning frequency layers UE supports”. |
| Huawei/HiSilicon | Propose to have N=6 for component 3.  Fine to have N=32 for component 3 proposed by MTK.  Fine to have additional component “max number of positioning frequency layer per band”; not OK without the highlighted per band, as the FG is reported per band. |

Based on the above feedbacks, following agreements were made.

**Agreements:**

* **FFS text in components of FG13-1 is removed**
* **Notes for component 3 of FG13-1 is moved to Note column**
* **FFS: additional candidate value(s) of component 3 (e.g., 6, 32)**
* **FFS: Add additional component “max number of positioning frequency layer per band”**
* **FFS: Add 48 as candidate value of component 4 of FG13-1 and other values in brackets are removed**
* **FFS: Change “X%” to “30%” for FG13-1 (depending on [101-e-NR-Pos-01])**
* **Need for the gNB to know if the feature is supported is “No” for FG13-1**

**Updated FL proposal 1:**

* **Add N=6 and N=32 as additional candidate values of component 3**
* **Add additional component “max number of positioning frequency layer per band”**
* **Add 6, 24 and 48 as candidate values of component 4 of FG13-1**

Companies are encouraged to discuss further on FFS points in the above agreements.

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Support. |
| MTK | Support FL proposal |
| QC | Support |
| CATT | Support |
|  |  |
|  |  |
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**Agreements:**

* **Add N=6 and N=32 as additional candidate values of component 3**
* **FFS: Add additional component “max number of positioning frequency layer per band”**
* **Add 6, 24 and 48 as candidate values of component 4 of FG13-1**

**Updated FL proposal 1a:**

* **A new FG for max number of positioning frequency layers UE supports across all positioning methods across all bands is introduced**
  + **Values = {1, 2, 3, 4}**
  + **Type of this FG is per UE**
* **FFS: Add additional component “max number of positioning frequency layer per band” for FG13-1**
* **FFS: Change “X%” to “30%” for FG13-1 (depending on [101-e-NR-Pos-01])**

Companies are encouraged to discuss further on FFS points in the above agreements and updated FL proposal 1a.

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | We do not see the need to have “max number of PFL per band”  OK with 30%. |
| Qualcomm | We think it is important to have a max number of layers across all methods and bands. We are OK to 30%. |
| MTK | * OK to add the new FG.   The type is per UE, with the value {1,2,3,4} being signaled for FR1-only, FR2-only, FR1 in FR1/FR2 mixed operation, and FR2 in FR1/FR2 mixed operation.  That is:   * Max number of positioning frequency layers UE supports for FR1-only   + Values = {1, 2, 3, 4} * Max number of positioning frequency layers UE supports for FR2-only   + Values = {1, 2, 3, 4} * Max number of positioning frequency layers UE supports for FR1 in FR1/FR2 mixed operation   + Values = {1, 2, 3, 4} * Max number of positioning frequency layers UE supports for FR2 in FR1/FR2 mixed operation   + Values = {1, 2, 3, 4} * As such, no need to have “max number of positioning frequency layer per band” for FG13-1.   OK with X% = 30% |
| CATT | We don’t think we should add additional component “max number of positioning frequency layer per band” for FG13-1.  Support change “X%” to “30%”, since [101-e-NR-Pos-01] had agreed that the maximum value of X = MGL/MGRP supported in specification should not exceed 30%. |
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Based on the above feedbacks, following agreements were made.

**Agreements:**

* **A new FG for max number of positioning frequency layers UE supports across all positioning methods across all bands is introduced**
  + **Values = {1, 2, 3, 4}**
  + **Type of this FG is per UE**
* **Change “X%” to “30%” for FG13-1**

## 2.2 FG13-2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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 ignalling: 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] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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 FR1  Values = {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. |
| Moderator (NTT DOCOMO) | Further discussion on components seems necessary.  Companies are encouraged to provide views on following points.   * Necessity of max number of frequency layers as component * Whether separate candidate values sets for FR1 and for FR2 (and for mixed FR1/FR2) are necessary or not * Necessity of additional candidate value(s) of each component   Although there is a comment that this FG should be Per band, it seems all other companies are ok with Per UE according to contributions (and no other inputs for per band).  Therefore, suggestion is to agree on FL proposal (Per UE). |
| Huawei/HiSilicon | Support to have maximum number of frequency layers in total across all bands  Support to have separate candidate value sets for FR1 and for FR2 and for mixed FR1/FR2 at least for some components.  Support per UE with clarification that this FG is not applicable to PRS on unlicensed bands (n46) |
| LG | In our view, “per UE” is appropriate for this FG type. In component 4, it is described that “across all positioning frequency layers per UE”, and we prefer to keep it. If needed, we are fine with adding a note which implies that this FG is valid for the licensed bands.  For the points from FL,   * Necessity of max number of frequency layers as component: If this means component 6 of this FG, we support this. * Whether separate candidate values sets for FR1 and for FR2 (and for mixed FR1/FR2) are necessary or not: differentiation for FR1 an FR2 may be necessary.   Necessity of additional candidate value(s) of each component: We prefer to keep “ 3 “ of component 4. |
| Huawei/HiSilicon 0601 | Values of component 3 and 5 need FFS. |
| Qualcomm | It is not true that NR Positionign is limited to licensed bands. We cannot agree for per UE reporting. |

**Updated FL proposal 2:**

* **Components and candidate values for FG13-2 are as below**
  + **Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE.**
    - **Values = {1, 2}**
  + **Max number of DL PRS Resources per DL PRS Resource Set for FR1**
    - **Values = {2, 4, 8}**
  + **Max number of DL PRS Resources per DL PRS Resource Set for FR2**
    - **Values = {2, 4, 8, 16, 32, 64}**
  + **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}**
  + **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, 64, 96, 128, 192, 256, 512, 1024, 2048}**
  + **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}**
  + **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}**
  + **Max number of TRPs across all positioning frequency layers per UE.** 
    - **Values = {6, 12, 16, 24, 32, 64, 128, 256}**
  + **Max number of DL PRS Resources per FR1 positioning frequency layer.** 
    - **Values = {6, 24, 32, 64, 128, 256, 512, 1024}**
  + **Max number of DL PRS Resources per FR2 positioning frequency layer.** 
    - **Values = {24, 32, 64, 96, 128, 256, 512, 1024}**
  + **Max number of positioning frequency layers UE supports**
    - **Values = {1, 2, 3, 4}**
* **Type of FG13-2 is “Per UE”**
  + **Need of FDD/TDD differentiation is “No”**
  + **Need of FR1/FR2 differentiation is “Yes”**
  + **Note that this FG is only applicable to licensed bands**

Companies are encouraged to discuss further on above updated FL proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Support. Perhaps we do not need FRx differentiation anymore. |
| Nokia/NSB | Support FL proposal |
| MTK | If each component is designed with values corresponding to FRs, then FRx differentiation is not needed, in our understanding.  For “Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets”, we propose to simply the design as:   * Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 (including FR1-only and FR1 in FR1/FR2 mixed operation).   + Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048} * Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 (including FR2-only and FR2 in FR1/FR2 mixed operation).   + Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}   For “Max number of positioning frequency layers UE supports”, the value {1,2,3,4} is signaled for FR1-only, FR2-only, FR1 in FR1/FR2 mixed operation, and FR2 in FR1/FR2 mixed operation.  That is:   * Max number of positioning frequency layers UE supports for FR1-only   + Values = {1, 2, 3, 4} * Max number of positioning frequency layers UE supports for FR2-only   + Values = {1, 2, 3, 4} * Max number of positioning frequency layers UE supports for FR1 in FR1/FR2 mixed operation   + Values = {1, 2, 3, 4} * Max number of positioning frequency layers UE supports for FR2 in FR1/FR2 mixed operation   + Values = {1, 2, 3, 4} |
| Qualcomm | Per Band reporting. The FR1-only values correspond to an FR1-band. The FR2-only values correspond to an FR2-band. The The FR1/FR2-mixed values correspond to an FR1-band & FR2-band, etc. |
| Huawei/HiSilicon | We do not think what QC proposed can work. |
| Qualcomm2 | First, we clearly don’t agree that this is FG is applicable only to licensed bands. If indeed per-band reporting does not work, we propose at least the FR1 components to be reported per FR1-band. From our understanding, RAN2 can handle such a case, where there are different types inside the same FG.  This is not only due to the licensed/unlicensed operation. We know that at low-bands, just 1 PRS resource per PRS resource set per TRP would be enough; there are no Tx beams to be swept from the Tx side. At mid bands, maybe a more likely deployment could be 4 PRS reosurces per set, whereas at high bands it would be 8 PRS resources. Depending on whether the UE supports PRS processing in a band (FG13-1), the corresponding number of PRS resources per set would be adjusted for that band and the likely/available deployments. If that is the case, then also all the max number of PRS resources across sets/layers/trps would be adjusted accordingy. That is, we propose as a compromise to report the folowin components per FR1 band, and the remaining per UE.   * + **Max number of DL PRS Resources per DL PRS Resource Set for FR1**     - **Values = {2, 4, 8}**   + **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}**   + **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}**   + **Max number of DL PRS Resources per FR1 positioning frequency layer.**      - **Values = {6, 24, 32, 64, 128, 256, 512, 1024}**   This comment applies to Proposal 3 and 4 also.  **Question 1:** What does the word “optional” refer to in the component: “Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only. (optional)”. This is an optional feature group.  **Question 2:** How do we interpret the “FR1/FR2 mixed operation”? Is it, “the UE is configured with at least one positioning frequency layer in FR1 and FR2”?  **Question 3**: Why are values 64, 128 missing from the component of FR2 in FR1/FR2 mixed operation?   * + **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, 64, 96, 128, 192, 256, 512, 1024, 2048}**   + **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}** |
| Huawei/HiSilicon | We don’t think the logical can work having a capability defined as something that is counted across all bands is somehow reported per band, and having further interpretation that the capability in case of inter-band operation will be the minimum.  One example is that UE reports Z1 in band A, and Z2<Z1 in band B, and   * In case of band A standalone, UE support Z1, while * In case of band A + band B, UE can only support Z2<Z1.   I won’t use the term that spec is broken, but the functionality is severely compromised.  Transmitting PRS on unlicensed bands has never ever been discussed either in NR-Pos or in NR-U, and as far as we know, gNB should not be allowed to transmit PRS simultaneously due to regulation on unlicensed bands.  Having some components reported per FR1 band, while remaining per UE will overcomplicate the UE capability design. The compromise that we can accept is provided as follows   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | 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 TRPs across all positioning frequency layers per UE.   Values = {3, 6, 12, 16, 24, 32, 64, 128, 256}   1. Max number of positioning frequency layers UE supports   Values = {1, 2, 3, 4} | 13-1 | No | N/A |  | [Per UE] | | 13-2a | DL PRS Resources for DL AoD on a band | 1. Max number of DL PRS Resources per DL PRS Resource Set   Values = {2, 4, 8, 16, 32, 64}  Note: 16, 32, 64 are only applicable to FR2 bands   1. Max number of DL PRS Resources per positioning frequency layer.   Values = {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: 6 is only applicable to FR1 bands | 13-1 | No | N/A |  | Per band | | 13-2b | DL PRS Resources for DL AoD on a band combination | 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}  Note this is reported for FR1 only BC.   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, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC   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}  Note this is reported for BC containing FR1 and FR2 bands   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, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands | 13-1 | No | N/A |  | Per BC |   I hope this would be acceptable to all. This may also be applicable to FG13-3 and FG13-4, with the only exception that   * FG13-3a/4a: component 1 should include 1, and component 2 should include 3. * FG13-3b/4b: component 1 and component 3 should include 3. |
| MTK | * First, we propose to add a value 64 for 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, 64, 96, 128, 192, 256, 512, 1024, 2048}   * We don’t agree with QC’s comments   + If there is only 1 PRS resource per PRS resource set per TRP, then DL-AoD positioning will not work. Thus we don’t think it is typical to have 1 PRS resource per PRS resource set per TRP at low-bands.   + It is possible that at different bands the NW may have different PRS configuraitons, but the main difference is FR1 and FR2, so it is reasonable to have the type per UE with FRx differentiation.   A sufficient reason to have the FG per band signalling is that UE has different capabilities in different bands.  If this is QC’s concern, we can agree the following components being per band signalling:   * **Max number of DL PRS Resources per DL PRS Resource Set** * **Max number of DL PRS Resources per FR1 positioning frequency layer**   But we cannot agree the following components being per band signalling (as we believe the intention is to limit the PRS configuration to UE across all bands in FR1/FR2)   * **Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets**   HW suggests to have have this component per BC (limited within FR1 or FR2 or mixed FR1-FR2).  This might work. Howevetr, in our view, the signaling overhead is too heavy.  We still prefer have this component per UE signalling with FRx differentiation   * Regarding the component “**Max number of positioning frequency layers UE supports**”, we don’t think it is needed if our view in FL proposal 1a is agreed   These comments also apply to FL proposal 3 and 4. |
| LG | Support this proposal from FL. In our understanding, we did not considered unlicensed band for NR PRS design, so we are not sure if it is appropriate for introducing the designed NR PRS to the unlicensed bands. In the current phase, we prefer to explicitly describe that each FG is for licensed bands only regardless of decision of type. |
| Qualcomm3 | We are generally OK with the new proposal from HW.   * A note though is that we still have concerns adding the value [3] in Component 2 of 13-2   To MTK, the example of “1 beam” for low-band and “4 beams” or “8 beams” for mid and high bands in FR1 is just an example. We are not discussing just FG13-2 here, but also FG13-3, FG13-4. There would be huge differences in the deployment of PRS in 600 Mhz vs the 4 GHz, so it is not enough to have only FR differentiation. |
| CATT | Support FL’s proposal. We don’t need FDD/TDD differentiation, but FR1/FR2 differentiation is needed. |

**Agreements:**

* **FG13-2 is restructured as below**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 TRPs across all positioning frequency layers per UE.   Values = {[3], 6, 12, 16, 24, 32, 64, 128, 256}   1. Max number of positioning frequency layers UE supports   Values = {1, 2, 3, 4} | 13-1 | No | N/A |  | Per UE |
| 13-2a | DL PRS Resources for DL AoD on a band | 1. Max number of DL PRS Resources per DL PRS Resource Set   Values = {2, 4, 8, 16, 32, 64}  Note: 16, 32, 64 are only applicable to FR2 bands   1. Max number of DL PRS Resources per positioning frequency layer.   Values = {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: 6 is only applicable to FR1 bands | 13-1 | No | N/A |  | Per band |
| 13-2b | DL PRS Resources for DL AoD on a band combination | 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}  Note this is reported for FR1 only BC.   1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.   Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC   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}  Note this is reported for BC containing FR1 and FR2 bands   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, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands | 13-1 | No | N/A |  | Per BC |

### **Updated FL proposal 2:**

* **Candidate value [3] for component 2 of FG13-2 is kept**
* **Type of FG13-2b is Per BC**

Companies are encouraged to discuss further on above updated FL proposal.

|  |  |
| --- | --- |
| Company | Comment |
| MTK | Regarding FG13-2b, we would like to add a note that: “The reported value is the total number across all bands in the corresponding BC” |
| Huawei/HiSilicon 0604 | Suggest to keep 3, to keep the possibility of a low-end UE.  Suggest to report per BC. The overhead can be overcome by RAN2 signaling design through introducing a *FeatureBC* structure, and referencing the same *FeatureBC-ID* in different BCs, in case the same per BC capability is reported across different BCs.  Support the note proposed by MTK. |
| CATT | Support FL proposal.  We share the same view with MTK. One note can be added to clarify the meaning of reported values, i.e., across all bands in the BC. |
|  |  |

## 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.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [3] | * Per UE and differentiated for FR1 and FR2. * For component 4, the value 3 should be reserved for low cost UE.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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 numbers  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 FR1  Values = {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. |
| Moderator (NTT DOCOMO) | Further discussion on components and type seems necessary.  Companies are encouraged to provide views on following points.   * Necessity of max number of frequency layers as component * Whether separate candidate values sets for FR1 and for FR2 (and for mixed FR1/FR2) are necessary or not * Necessity of additional candidate value(s) of each component * Type and FRx differentiation |
| Huawei/HiSilicon | Support to have maximum number of frequency layers in total across all bands  Support to have separate candidate value sets for FR1 and for FR2 and for mixed FR1/FR2 at least for some components.  Support per UE with clarification that this FG is not applicable to PRS on unlicensed bands (n46) |
| LG | In our view, “per UE” is appropriate for this FG type. In component 4, it is described that “across all positioning frequency layers per UE”, and we prefer to keep it. If needed, we are fine with adding a note which implies that this FG is valid for the licensed bands.  For the points from FL,   * Necessity of max number of frequency layers as component: If this means component 6 of this FG, we support this. * Whether separate candidate values sets for FR1 and for FR2 (and for mixed FR1/FR2) are necessary or not: differentiation for FR1 an FR2 may be necessary.   Necessity of additional candidate value(s) of each component: We prefer to keep “ 3 “ of component 4. |
| Huawei/HiSilicon 0601 | Values of component 3 and 5 need FFS. |
| Qualcomm | It is not true that NR Positionign is limited to licensed bands. We cannot agree for per UE reporting. |
|  |  |

**Updated FL proposal 3:**

* **Components and candidate values for FG13-3 are as below**
  + **Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE.**
    - **Values = {1, 2}**
  + **Max number of DL PRS Resources per DL PRS Resource Set for FR1**
    - **Values = {2, 4, 8}**
  + **Max number of DL PRS Resources per DL PRS Resource Set for FR2**
    - **Values = {2, 4, 8, 16, 32, 64}**
  + **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}**
  + **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, 64, 96, 128, 192, 256, 512, 1024, 2048}**
  + **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}**
  + **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}**
  + **Max number of TRPs across all positioning frequency layers per UE.** 
    - **Values = {6, 12, 16, 24, 32, 64, 128, 256}**
  + **Max number of DL PRS Resources per FR1 positioning frequency layer.** 
    - **Values = {6, 24, 32, 64, 128, 256, 512, 1024}**
  + **Max number of DL PRS Resources per FR2 positioning frequency layer.** 
    - **Values = {24, 32, 64, 96, 128, 256, 512, 1024}**
  + **Max number of positioning frequency layers UE supports**
    - **Values = {1, 2, 3, 4}**
* **Type of FG13-3 is “Per UE”**
  + **Need of FDD/TDD differentiation is “No”**
  + **Need of FR1/FR2 differentiation is “Yes”**
  + **Note that this FG is only applicable to licensed bands**

Companies are encouraged to discuss further on above updated FL proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Support. Perhaps we do not need FRx differentiation anymore. |
| Nokia/NSB | Support FL proposal |
| MTK | If each component is designed with values corresponding to FRs, then FRx differentiation is not needed, in our understanding.  For “Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets”, we propose to simply the design as:   * Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 (including FR1-only and FR1 in FR1/FR2 mixed operation).   + Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048} * Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 (including FR2-only and FR2 in FR1/FR2 mixed operation).   + Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}   For “Max number of positioning frequency layers UE supports”, the value {1,2,3,4} is signaled for FR1-only, FR2-only, FR1 in FR1/FR2 mixed operation, and FR2 in FR1/FR2 mixed operation.  That is:   * Max number of positioning frequency layers UE supports for FR1-only   + Values = {1, 2, 3, 4} * Max number of positioning frequency layers UE supports for FR2-only   + Values = {1, 2, 3, 4} * Max number of positioning frequency layers UE supports for FR1 in FR1/FR2 mixed operation   + Values = {1, 2, 3, 4} * Max number of positioning frequency layers UE supports for FR2 in FR1/FR2 mixed operation   Values = {1, 2, 3, 4} |
| Qualcomm | Per Band reporting. The FR1-only values correspond to an FR1-band. The FR2-only values correspond to an FR2-band. The The FR1/FR2-mixed values correspond to an FR1-band & FR2-band, etc. |
| LG | Support this proposal from FL. In our understanding, we did not considered unlicensed band for NR PRS design, so we are not sure if it is appropriate for introducing the designed NR PRS to the unlicensed bands. In the current phase, we prefer to explicitly describe that each FG is for licensed bands only regardless of decision of type. |
| CATT | Support FL’s proposal. |
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**Agreements:**

* **FG13-3 is restructured as below**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 13-3 | DL PRS Resources for DL-TDOA | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE.   Values = {1, 2}   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 positioning frequency layers UE supports   Values = {1, 2, 3, 4} | 13-1 | No | N/A |  | Per UE |
| 13-3a | DL PRS Resources for DL-TDOA on a band | 1. Max number of DL PRS Resources per DL PRS Resource Set   Values = {1, 2, 4, 8, 16, 32, 64}  Note: 16, 32, 64 are only applicable to FR2 bands   1. Max number of DL PRS Resources per positioning frequency layer.   Values = {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: 6 is only applicable to FR1 bands | 13-1 | No | N/A |  | Per band |
| 13-3b | DL PRS Resources for DL-TDOA on a band combination | 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}  Note this is reported for FR1 only BC.   1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.   Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC   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}  Note this is reported for BC containing FR1 and FR2 bands   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, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands | 13-1 | No | N/A |  | Per BC |

### **Updated FL proposal 3:**

* **Candidate value [3] for component 2 of FG13-3 is kept**
* **Type of FG13-3b is Per BC**

Companies are encouraged to discuss further on above updated FL proposal.

|  |  |
| --- | --- |
| Company | Comment |
| MTK | Regarding FG13-3b, we would like to add a note that: “The reported value is the total number across all bands in the corresponding BC” |
| Huawei/HiSilicon 0604 | Suggest to keep 3, to keep the possibility of a low-end UE.  Suggest to report per BC. The overhead can be overcome by RAN2 signaling design through introducing a *FeatureBC* structure, and referencing the same *FeatureBC-ID* in different BCs, in case the same per BC capability is reported across different BCs.  Support the note proposed by MTK. |
| CATT | Support FL proposal.  We share the same view with MTK. One note can be added to clarify the meaning of reported values, i.e., across all bands in the BC. |
|  |  |

## 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.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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 | |
| [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 | 13-4 | 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**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 numbers  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 FR1  Values = {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. |
| Moderator (NTT DOCOMO) | Further discussion on components and type seems necessary.  Companies are encouraged to provide views on following points.   * Necessity of max number of frequency layers as component * Whether separate candidate values sets for FR1 and for FR2 (and for mixed FR1/FR2) are necessary or not * Necessity of additional candidate value(s) of each component * Type and FRx differentiation |
| Huawei/HiSilicon | Support to have maximum number of frequency layers in total across all bands  Support to have separate candidate value sets for FR1 and for FR2 and for mixed FR1/FR2 at least for some components.  Support per UE with clarification that this FG is not applicable to PRS on unlicensed bands (n46) |
| LG | In our view, “per UE” is appropriate for this FG type. In component 4, it is described that “across all positioning frequency layers per UE”, and we prefer to keep it. If needed, we are fine with adding a note which implies that this FG is valid for the licensed bands.  For the points from FL,   * Necessity of max number of frequency layers as component: If this means component 6 of this FG, we support this. * Whether separate candidate values sets for FR1 and for FR2 (and for mixed FR1/FR2) are necessary or not: differentiation for FR1 an FR2 may be necessary.   Necessity of additional candidate value(s) of each component: We prefer to keep “ 3 “ of component 4. |
| Huawei/HiSilicon 0601 | Values of component 3 and 5 need FFS. |
| Qualcomm | It is not true that NR Positionign is limited to licensed bands. We cannot agree for per UE reporting. |
|  |  |

**Updated FL proposal 4:**

* **Components and candidate values for FG13-4 are as below**
  + **Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE.**
    - **Values = {1, 2}**
  + **Max number of DL PRS Resources per DL PRS Resource Set for FR1**
    - **Values = {2, 4, 8}**
  + **Max number of DL PRS Resources per DL PRS Resource Set for FR2**
    - **Values = {2, 4, 8, 16, 32, 64}**
  + **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}**
  + **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, 64, 96, 128, 192, 256, 512, 1024, 2048}**
  + **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}**
  + **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}**
  + **Max number of TRPs across all positioning frequency layers per UE.** 
    - **Values = {6, 12, 16, 24, 32, 64, 128, 256}**
  + **Max number of DL PRS Resources per FR1 positioning frequency layer.** 
    - **Values = {6, 24, 32, 64, 128, 256, 512, 1024}**
  + **Max number of DL PRS Resources per FR2 positioning frequency layer.** 
    - **Values = {24, 32, 64, 96, 128, 256, 512, 1024}**
  + **Max number of positioning frequency layers UE supports**
    - **Values = {1, 2, 3, 4}**
* **Type of FG13-4 is “Per UE”**
  + **Need of FDD/TDD differentiation is “No”**
  + **Need of FR1/FR2 differentiation is “Yes”**
  + **Note that this FG is only applicable to licensed bands**
* **Need for the gNB to know if the feature is supported is “No” for FG13-4**

Companies are encouraged to discuss further on above updated FL proposal.

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Support. Perhaps we do not need FRx differentiation anymore. |
| Nokia/NSB | Support FL proposal. |
| MTK | If each component is designed with values corresponding to FRs, then FRx differentiation is not needed, in our understanding.  For “Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets”, we propose to simply the design as:   * Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 (including FR1-only and FR1 in FR1/FR2 mixed operation).   + Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048} * Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 (including FR2-only and FR2 in FR1/FR2 mixed operation).   + Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}   For “Max number of positioning frequency layers UE supports”, the value {1,2,3,4} is signaled for FR1-only, FR2-only, FR1 in FR1/FR2 mixed operation, and FR2 in FR1/FR2 mixed operation.  That is:   * Max number of positioning frequency layers UE supports for FR1-only   + Values = {1, 2, 3, 4} * Max number of positioning frequency layers UE supports for FR2-only   + Values = {1, 2, 3, 4} * Max number of positioning frequency layers UE supports for FR1 in FR1/FR2 mixed operation   + Values = {1, 2, 3, 4} * Max number of positioning frequency layers UE supports for FR2 in FR1/FR2 mixed operation   Values = {1, 2, 3, 4} |
| Qualcomm | Per Band reporting. The FR1-only values correspond to an FR1-band. The FR2-only values correspond to an FR2-band. The The FR1/FR2-mixed values correspond to an FR1-band & FR2-band, etc. |
| LG | Support this proposal from FL. |
| CATT | Support FL’s proposal. |
|  |  |
|  |  |

**Agreements:**

* **FG13-4 is restructured as below**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 13-4 | DL PRS Resources for Multi-RTT | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE.   Values = {1, 2}   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 positioning frequency layers UE supports   Values = {1, 2, 3, 4} | 13-1 | No | N/A |  | Per UE |
| 13-4a | DL PRS Resources for Multi-RTT on a band | 1. Max number of DL PRS Resources per DL PRS Resource Set   Values = {1, 2, 4, 8, 16, 32, 64}  Note: 16, 32, 64 are only applicable to FR2 bands   1. Max number of DL PRS Resources per positioning frequency layer.   Values = {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: 6 is only applicable to FR1 bands | 13-1 | No | N/A |  | Per band |
| 13-4b | DL PRS Resources for Multi-RTT on a band combination | 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}  Note this is reported for FR1 only BC.   1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.   Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC   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}  Note this is reported for BC containing FR1 and FR2 bands   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, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands | 13-1 | No | N/A |  | Per BC |

### **Updated FL proposal 4:**

* **Candidate value [3] for component 2 of FG13-4 is kept**
* **Type of FG13-4b is Per BC**

Companies are encouraged to discuss further on above updated FL proposal.

|  |  |
| --- | --- |
| Company | Comment |
| MTK | Regarding FG13-4b, we would like to add a note that: “The reported value is the total number across all bands in the corresponding BC” |
| Huawei/HiSilicon 0604 | Suggest to keep 3, to keep the possibility of a low-end UE.  Suggest to report per BC. The overhead can be overcome by RAN2 signaling design through introducing a *FeatureBC* structure, and referencing the same *FeatureBC-ID* in different BCs, in case the same per BC capability is reported across different BCs.  Support the note proposed by MTK. |
| CATT | Support FL proposal.  We share the same view with MTK. One note can be added to clarify the meaning of reported values, i.e., across all bands in the BC. |
|  |  |

## 2.5 FG13-5/5a

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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”**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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”. |
| Moderator (NTT DOCOMO) | I assume FL proposal on type of FG13-5a is acceptable to all.  Although there is a comment that FG13-5 should be Per band, it seems all other companies are ok with Per UE according to contributions (and no other inputs for per band).  Therefore, suggestion is to agree on FL proposal (Per UE). |
| Huawei/HiSilicon | Support Moderator’s suggestion. |
| LG | We support this proposal. |
| Qualcomm | It is not true that NR Positionign is limited to licensed bands. We cannot agree for per UE reporting. |
|  |  |

Based on the above feedbacks, following agreements were made.

**Agreements:**

* **FFS: 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”**

**Updated FL proposal 5:**

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

Companies are encouraged to discuss further on FFS points in the above agreements.

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Support. |
| Nokia/NSB | Support FL proposal |
| MTK | Support FL proposal |
| Qualcomm | Per band |
| Moderator (NTT DOCOMO) | Suggest to agree on FL proposal. |
| Huawei/HiSilicon | I heard that RAN4 is not going to define intra-frequency and inter-frequency PRS measurement, so we do not need FG13-5a. |
| Qualcomm | Again here, if a UE supports RSRP/RSTD reporting, it is likely that in a low-band there is no need of multiple RSRPs. Or overall, I hope it is understood that having multiple RSRPs/RSTD reporting is more useful for the case of multiple Tx beams (PRS resources per set). Therefore, this needs to be again reported per band, not only for the licensed/unlicensed differentiation, but due to the low/mid/band differentiation on the number of Tx beams. |
| Huawei/HiSilicon | We think the number of RSRP measurement on a particular band is also upper bounded by the number of resources per set supported by UE reported per band in our previous comment. Would that be OK to report this per UE taking that into account? |
| MTK | * FG13-5a is not need as RAN4 is not going to define intra-frequency and inter-frequency PRS measurement * We disagree with QC’s comments that in low-bands there is no need for multiple RSRPs.   A sufficient reason to have FG13-5 per band signalling is that UE has different capabilities in different bands.  If this is QC’s concern, we can accept FG13-5 being per band signalling.  But we still has the preference to have FG13-5 per UE with FRx differentiation.  We also agree to HW’s suggestion. |
| LG | Support this proposal from FL and FG13-5a needs to be removed. |
| CATT | Support FL’s proposal. We prefer to remove FG 13-5a. |

**Agreements:**

* **Type of FG13-5 is “Per UE”**
  + **Need of FDD/TDD differentiation is “No”**
  + **Need of FR1/FR2 differentiation is “Yes”**
* **Add a note “the number of RSRP measurement on a particular band is also upper bounded by the number of resources per set supported by UE reported per band”**

## 2.6 FG13-6/6a

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

**Updated FL proposal 6:**

* **“RSTD/[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 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”. |
| Moderator (NTT DOCOMO) | Further discussion on type of 13-6 seems necessary while I assume FL proposal on type of FG13-6a as well as on component 1/2 for FG13-6 is acceptable to all.  “RSTD” is removed in updated proposal according to suggestion from Qualcomm. |
| Huawei/HiSilicon | Support Moderator’s suggestion. |
| LG | We generally agree with FL’s proposal, but we would like to suggest to explicitly describe that the values of each component of FG 13-6 are the maximum number similar to the described in other FGs 13-3/4/5. |
| Qualcomm | It is not true that NR Positionign is limited to licensed bands. We cannot agree for per UE reporting. |
|  |  |

Based on the above feedbacks, following agreements were made.

**Agreements:**

* **“RSTD/[RSRP]” in FG name of FG13-6 is removed**
* **The component 1 and 2 of FG13-6 are kept (FFS: add “maximum number”)**
* **FFS: 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”**

### **Updated FL proposal 6:**

* **Type of FG13-6 is “Per UE”**
  + **Need of FDD/TDD differentiation is “No”**
  + **Need of FR1/FR2 differentiation is “Yes”**
* **Add a note “the number of RSTD/RSRP measurement on a particular band is also upper bounded by the number of resources per set supported by UE reported per band”**

Companies are encouraged to discuss further on FFS points in the above agreements.

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Support except “Maximum number of” for component 2 of FG13-6. |
| Nokia/NSB | Support FL proposal |
| MTK | Support except “Maximum number of” for component 2 of FG13-6. |
| Qualcomm | Per band |
| Moderator (NTT DOCOMO) | “Clarify that component 1 and 2 of FG13-6 are “Maximum number of” measurements” is removed from the proposal.  Suggest to agree on FL proposal. |
| Huawei/HiSilicon | I heard that RAN4 is not going to define intra-frequency and inter-frequency PRS measurement, so we do not need FG13-6a. |
| Qualcomm | Again here, if a UE supports RSRP/RSTD reporting, it is likely that in a low-band there is no need of multiple RSRPs. Or overall, I hope it is understood that having multiple RSRPs/RSTD reporting is more useful for the case of multiple Tx beams (PRS resources per set). Therefore, this needs to be again reported per band, not only for the licensed/unlicensed differentiation, but due to the low/mid/band differentiation on the number of Tx beams. |
| Huawei/HiSilicon | We think the number of RSTD/RSRP measurement on a particular band is also upper bounded by the number of resources per set supported by UE reported per band in our previous comment. Would that be OK to report this per UE taking that into account? |
| MTK | * FG13-6a is not need as RAN4 is not going to define intra-frequency and inter-frequency PRS measurement * We disagree with QC’s comments that in low-bands there is no need for multiple RSRPs.   A sufficient reason to have FG13-5 per band signalling is that UE has different capabilities in different bands.  If this is QC’s concern, we can accept FG13-6 being per band signalling.  But we still has the preference to have FG13-6 per UE with FRx differentiation.  We also agree to HW’s suggestion. |
| LG | Support this proposal from FL and FG13-5a needs to be removed. |
| CATT | Support FL’s proposal. We prefer to remove FG 13-6a. |
| Moderator (NTT DOCOMO) | Based on feedbacks so far, similar note as for FG13-5 is added in the updated proposal. |
| Nokia, NSB | Support FL proposal |
| Huawei/HiSilicon 0604 | Agree with FL recommendation. Per UE. |

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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.

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

**Updated 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”**
* **Note is [removed or kept]**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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. |
| Moderator (NTT DOCOMO) | Further discussion on the need for LMF to know seems necessary.  Although there is a comment that why this FG should be Per FS, it seems all other companies are ok with Per FS according to contributions (and no other inputs for type).  Therefore, suggestion is to agree on FL proposal (Per FS).  I assume other parts of the proposal are acceptable to all. |
| CATT | We prefer to let location server to know. In our point of view, if the FG of max number of SRS Resource Sets for positioning supported by UE per BWP is known by LMF, more information will be benefit for LMF. In addition, we would like to ask what are the disadvantages of supporting LMF to know this information. Huawei comments to worry on over-exposure of UE radio capability to core network as core network already has UE permanent ID, but this information is known by core network, not base stations, we cannot understand why it is a problem indicated by Huawei in the above comments.  PS: We are discussing “max number of SRS Resource Sets” in this FG, we cannot understand why Huawei mention **UE CA capability** in above comments. |
| Huawei/HiSilicon | Support Moderator’s suggestion.  Reply to Nokia/Moderator   * + - 1. Regarding why it is per FS, it is because similar capability was reported per FS (in FeatureSetUplink) in Rel-15.       2. This per FS reporting allows UE to report how to allocate the processing units on each band for a CA band combination across all supported CA band combinations. This could happen if no SRS processing units are allocated for a band x in a band combination A, while some SRS processing units are allocated for the band x in another band combination B   Reply to CATT:   * + - 1. Note that this is reported per FS, which is equivalent to per band per band combination. In summary, UE will report all its supported CA band combinations, and in each CA band combinations, UE will report the FG on each band. Note that this capability on a certain band may be different depending on which band combination this band is in. For example, capability in band A will be different for band combination A+B and for band combination A+B+C, simply because UE does not have so many Tx and does not have so much processing resource.       2. Having permanence ID is different from having permanent ID plus its radio capability: ID is associated with SIM, capability is associated with the chipset/cellphone.       3. Having the CA capability does not mean LMF will know the current CA configuration. E.g, UE reports it supports the following CA band combniations, and the capability on each band for each CA band combination          * Band A          * Band A+B          * Band A+B+C   Knowing that does not means that LMF would know that currently UE is configured with inter-band CA with Band A+B, nor does it mean that LMF would know any intra-band CA configuration within Band A.   * + - 1. Even if the LMF is so powerful to know the CA configuration, current RAN3 signaling provides little assistance from LMF to recommend SRS configuration at gNB, after I check the latest RAN3 contribution. |

Based on the above feedbacks, following agreements were made.

**Agreements:**

* **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**
* **FFS: Type of FG13-8/8a/8b is “Per FS”**
* **FFS: Note is [removed or kept]**

**Updated FL proposal 7:**

* **Type of FG13-8/8a/8b is “Per FS”**
  + **FFS: necessary note for reason why per FS**
* **Note for FG13-8/8a/8b is removed**

Companies are encouraged to discuss further on FFS points in the above agreements.

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Support. |
| Nokia/NSB | Support FL proposal, just noting that RAN2 expects RAN1 to explain the choice for “Per FS”. |
| MTK | Support FL proposal |
| **Qualcomm** | **~~Per band~~ (Wrong). This is per FS, agre with the reply from HW** |
| Moderator (NTT DOCOMO) | Suggest to agree on FL proposal with some necessary note for reason why per FS. |
| Huawei/HiSilicon | To QC, why it is per band?  The reason why it is per FS can be found in our reply ealier, copied below.   * + - 1. Regarding why it is per FS, it is because similar capability was reported per FS (in FeatureSetUplink) in Rel-15.       2. This per FS reporting allows UE to report how to allocate the processing units on each band for a CA band combination across all supported CA band combinations. This could happen if no SRS processing units are allocated for a band x in a band combination A, while some SRS processing units are allocated for the band x in another band combination B |
| CATT | Support FL’s proposal. |
|  |  |

**Agreements:**

* **Type of FG13-8/8a/8b is “Per FS”**
  + **Add a note “Per FS is selected because similar capability was reported per FS (in FeatureSetUplink) in Rel-15”**
* **Note for FG13-8/8a/8b is removed**

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [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.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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?  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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.

We prefer to let location server to know. In our point of view, if the FG of max number of SRS Resource Sets for positioning supported by UE per BWP is known by LMF, more information will help LMF to configure and coordinate the transmission of SRS-Pos. In addition, we would like to ask what are the disadvantages of supporting LMF to know this information. Huawei comments to worry on over-exposure of UE radio capability to core network as core network already has UE permanent ID, but this information is known by core network, not base stations, we cannot understand why it is a problem indicated by Huawei in the above comments.

**Updated 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**
* **Note is [removed or kept]**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | 13-1  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 | 13-9a | 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 |
| Moderator (NTT DOCOMO) | Further discussion on need for LMF to know seems necessary. I assume other parts of the proposal are acceptable to all. |
| CATT | We prefer to let location server to know. In our point of view, if the FG of OLPC for SRS for positioning based on PRS/SSB/CSI-RS is known by LMF, more information will be benefit for LMF. In addition, we would like to ask what are the disadvantages of supporting LMF to know this information. Huawei comments to worry on over-exposure of UE radio capability to core network as core network already has UE permanent ID, but this information is known by core network, not base stations, we cannot understand why it is a problem indicated by Huawei in the above comments. |
| Huawei/HiSilicon | Reply to CATT  Support of pathloss will not help LMF to assist gNB to configure pathloss reference of SRS for positioning at all based on the latest RAN3 contribution. |
| LG | Support FL’s proposal and we prefer to keep the note. |
|  |  |

Based on the above feedbacks, following agreements were made.

**Agreements:**

* **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**
* **FFS: Note is [removed or kept]**

### **Updated FL proposal 8:**

* **Note for FG13-9/9a/9b/9c is kept**

Companies are encouraged to discuss further on FFS points in the above agreements.

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | We do not agree with Note should be kept.  LMF can do nothing about pathloss on SRS. |
| Nokia/NSB | Support FL proposal |
| MTK | We prefer to remove the note. In LPP 37.355, the power of SSB and PRS are not optional information. Thus, there is no need for LMF to know whether UE supports FG13-9/9a/9b/9c |
| Qualcomm | Both LMF and gNB should know |
| Moderator (NTT DOCOMO) | More inputs from other companies are necessary. |
| Huawei/HiSilicon | Even if UE reports its capability to LMF, e.g. band A capability + band B capability. LMF has no idea whether UE has SCell configured in band B. |
| LG | Support FL Proposal. |
| CATT | Support FL’s proposal. LMF should know such information. |
| Moderator (NTT DOCOMO) | More companies are ok to keep the note. So, suggestion from moderator is to agree on current proposal. |
| Nokia/NSB | Support FL proposal |
| Huawei/HiSilicon 0604 | Should be left to RAN2 to discuss, as the signaling between LMF to gNB should be discussed by RAN2 and implemented by RAN3.  We also have concern that by agreeing all this, UE is mandated to report those components to LMF; because if UE does not, LMF would consider UE not supporting it. Please also refer to our clarification in 2.14 (copied below). There could be the case that UE simply does not want to report those capabilities to LMF, while UE still supports it.   |  | | --- | | 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. |   Propose to change the note in FG13-9/9a/9b/9c to “Need for location server to know if the feature is supported and the corresponding reporting type if reported to LMF are up to RAN2”. |

## 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 understanding  The 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.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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.

**Updated 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**
* **Note is [removed or kept]**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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** |
| Moderator (NTT DOCOMO) | Further discussion on the need for LMF to know seems necessary. I assume other parts of the proposal are acceptable to all. |
| CATT | We prefer to let location server to know. In our point of view, if the FG of spatial relation for SRS for positioning based on SSB/SRS/CSI-RS/PRS is known by LMF, more information will be benefit for LMF.. In addition, we would like to ask what are the disadvantages of supporting LMF to know this information. Huawei comments to worry on over-exposure of UE radio capability to core network as core network already has UE permanent ID, but this information is known by core network, not base stations, we cannot understand why it is a problem indicated by Huawei in the above comments. |
| Huawei/HiSilicon | Reply to CATT:  RAN2 made the agreement that LMF may recommend the spatial relation to the serving gNB to configure spatial relation of SRS for positioning, and the LS has been sent to RAN3 in this meeting. To allow LMF to make a better decision, we suggest to have FG13-10d, and FG13-10e reported as well to LMF, so that LMF knows that UE supports spatial relation towards a non-serving cell, and makes the correct recommendation of spatial relation to the serving gNB to assist serving gNB to configure the spatial relation of SRS for positioning.  Other components is not needed, as serving gNB may the decision on its own when configuring SRS for positioning. |
| LG | We would like to clarify “inter-band” spatial relation info. In configuration of the spatial relation information of both the SRS resource for MIMO and the SRS resource for positioning, there is “sevingCellIndex” which indicates CC. If we correctly know, spatial relation information configuration across CC has been already supported. We are not sure if this feature needs to be restricted to the same band. |

Based on the above feedbacks, following agreements were made.

**Agreements:**

* **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**
* **FFS: Note is [removed or kept]**

### **Updated FL proposal 9:**

* **Note for FG13-10/10a/10b/10c/10d/10e is kept**
* **Add “in the same band” in component description for 13-10/10a/10b/10c/10d/10e**

Companies are encouraged to discuss further on FFS points in the above agreements.

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | No need to let LMF know all of them. Propose only to keep the capability with respect to neighbouring cell/TRPs, so that LMF can make the spatial recommendation of neighbouring TRPs to the serving gNB. |
| Nokia/NSB | Support FL proposal |
| MTK | Agree with HW’s view |
| Qualcomm | Both LMF and gNB should know |
| Moderator (NTT DOCOMO) | More inputs from other companies are necessary on first bullet of the proposal.  Second bullet seems acceptable to all. |
| Huawei/HiSilicon | Even if UE reports its capability to LMF, e.g. band A capability + band B capability. LMF has no idea whether UE has SCell configured in band B. |
| LG | Support FL’s proposal. |
| CATT | Support FL’s proposal. LMF should know such information. |
| Moderator (NTT DOCOMO) | More companies are ok to keep the note. So, suggestion from moderator is to agree on current proposal. |
| Nokia/NSB | Support FL proposal |
| Huawei/HiSilicon 0604 | We have concerns on the part for the serving gNB (FG13-10/10a/10b). It is useless, since serving gNB can have better knowledge on the spatial relation configuration for SRS than LMF.  We also have concern that by agreeing all this, UE is mandated to report those components to LMF; because if UE does not, LMF would consider UE not supporting it. Please also refer to our clarification in 2.14 (copied below). There could be the case that UE simply does not want to report those capabilities to LMF, while UE still supports it.   |  | | --- | | 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. |   Propose to only keep the note in FG13-10c, 13-10d, and 13-10e with the following modification, and move notes in other FGs.  Need for location server to know if the feature is supported. The corresponding reporting type if reported to LMF is up to RAN2. |

## 2.10 FG13-11a/[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 betw aseen 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 ignalling**
    - **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.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | To align with RAN2’s specification, we propose to add a component to FG 13-11 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 | [13-11] | [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 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 ignalling: Per UE * FG 13-11   + Support   + Pre-requisite: 13-4 and 13-8   + Type of ignalling: 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.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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).***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **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 | We updated our view, as in ED#01, we support FG13-11 covers the case that SRS and DL PRS are on the same band.  For FG13-11a, we propose to change the description “PRS and SRS used for the measurements are in a different band” to “ PRS and SRS used for the measurements may in different bands” |
| Moderator (NTT DOCOMO) | Further discussion on type and necessity of “PRS and SRS used for the measurements are in the same band” for 13-11 seems necessary. Other parts for 13-11a are assumed to be acceptable to all. |
| CATT | We share the same view with MTK that for FG13-11a, change the description “PRS and SRS used for the measurements are in a different band” to “ PRS and SRS used for the measurements may in different bands”. |
| Huawei/HiSilicon | Unclear why inter-frequency measurement for DL-AoD and DL-TDOA are per band, while that for Multi-RTT is per UE.  Suggest to have per band, and OK to have they can be in different bands. |
| LG | We support per band for the type of this FG. Except of this, we are supportive of FL’s proposal. |

Based on the above feedbacks, following agreements were made.

**Agreements:**

* **FFS: 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**
* **FFS: 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**

**Updated 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 may be in a different band” in component description of FG13-11a**
* **Type of FG13-11a is “Per band”**

Companies are encouraged to discuss further on FFS points in the above agreements.

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Support. |
| Nokia/NSB | Support FL proposal |
| MTK | Support FL proposal |
| Qualcomm | Support |
| Moderator (NTT DOCOMO) | Suggest to agree on FL proposal. |
| Huawei/HiSilicon | I heard that RAN4 is not going to define intra-frequency and inter-frequency PRS measurement, so we do not need FG13-11a. |
| MTK | FG13-11a is not need as RAN4 is not going to define intra-frequency and inter-frequency PRS measurement |
| CATT | Support FL’s proposal. |
| Moderator (NTT DOCOMO) | Need more inputs on whether we should remove FG13-11a or we should modify FG13-11a (if so, how to modify). |
| Qualcomm | we think we need to keep 13-11a, as we sent before. Keep it per band, and just introduce the components:  *1.       Support of measurements derived on DL PRS resource/resource sets which are in different positioning frequency layers*  *2.       Support of  measurements derived on PRS and SRS which may be in a different band* |
| Moderator (NTT DOCOMO) | FL proposal 10 is updated according to above comment. |
|  |  |

### **Updated FL proposal 10:**

* **FG13-11a is kept with following components.**
  + **1. Support of measurements derived on DL PRS resource/resource sets which are in different positioning frequency layers**
  + **2. Support of measurements derived on PRS and SRS which may be in a different band**
* **Type of FG13-11a is “Per band”**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon 0604 | I am a bit confused at the new proposed components.  For component 1, I thought the intention was single SRS can used to associate DL PRS from multiple positioning frequency layers. Otherwise, we do not need component 1, since number of PRS positioning frequency layer for multi-RTT positioning is already covered by FG13-4. Suggest the following change for clarification.  For component 2, I would rather put that in the note than saying that UE support such a measurement that PRS and SRS may be in different bands.  Also the comment from Alex in ED#1   |  | | --- | | With regards to the association of PRS/SRS on different bands, we think the spec supports it. It is not up to UE implementation. What we said in the all ED is that there is no additional signaling, but this does not mean that it is up to UE implementation. A UE can still be configured with PRS in one band and SRS in another band, there is nothing that excludes that, and there is no ambiguity in this case. So, we cannot agree removing the inter-frequency RTT without explicitly covering this aspect. |   When I say it is up to implementation is that if we have two SRS bands and multiple PRS bands, how to pair them is up to UE implementation, and UE may select the pair that is not desired by the network without notifying LMF at all; howevere if we only have single SRS bands, there is only one way of pairing for sure. What confuses me is that which alternative should be adopted?   * Alt.1 UE is allowed to only report the PRS layer(s) that is in the same band as SRS and ignore the PRS layers that is not in the same band as SRS * Alt.2 UE shall report all PRS layers within its measurement capability that is detected, associated with the single SRS band   If it is not clarified, we suggest the following wording, i.e. Alt.1. Note that the new FG name has not been decided yet.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 13. NR Positioning | 13-11a | SRS-PRS association for Multi-RTT | 1. Support of measurements derived on DL PRS resource/resource sets which are in different positioning frequency layers for SRS transmitted in a single CC.   Note: ~~Support of measurements derived on~~ PRS and SRS ~~which~~ may be in a different band | 13-4 and 13-8 | |
|  |  |

## FG13-13

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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 | 13-13 | 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 ignalling**
    - **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 ignalling: 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 | 13-13 | 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”**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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. |
| Moderator (NTT DOCOMO) | Although there is a comment that this FG should be Per UE, it seems all other companies are ok with Per band according to contributions (and no other inputs for per UE).  Therefore, suggestion is to agree on FL proposal (Per band). |
| Huawei/HiSilicon | Per band should be OK. For example, UE support it in FR1 bands, but not in FR2 band, which requires some Rx beam operation. |
| Nokia/NSB (2nd iteration) | Explanation from Huawei/HiSi above is fine, but in that case it would be enough to be Per UE with FRx differentiation, which would be fine for us as well. |
| MTK | We support per UE with FR differentiation.  But if strong view exists for per band ignallin, we are fine to compromise. |
| Moderator (NTT DOCOMO) | Suggest to agree on FL proposal or per UE with FR differentiation. |
| Nokia/NSB | We support per UE with FRx differentiation |

## FG13-14

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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 | 13-14 | 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 ignalling**
    - **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 ignalling: 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. |
| Moderator (NTT DOCOMO) | Although there is a comment that this FG should be Per UE, it seems all other companies are ok with Per band according to contributions (and no other inputs for per UE).  Therefore, suggestion is to agree on FL proposal (Per band). |
| Huawei/HiSilicon | Per band should be OK. For example, UE support it in FR1 bands, but not in FR2 band, which requires some Rx beam operation. |
| Nokia/NSB (2nd iteration) | Explanation from Huawei/HiSi above is fine, but in that case it would be enough to be Per UE with FRx differentiation, which would be fine for us as well. |
| MTK | We support per UE with FR differentiation.  But if strong view exists for per band ignallin, we are fine to compromise. |
| Moderator (NTT DOCOMO) | Suggest to agree on FL proposal or per UE with FR differentiation. |
| CATT | Support FL’s proposal and it should be per band. |
| Nokia/NSB | We support per UE with FRx differentiation |

## 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.

**Updated 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”**
* **Note “Need for location server to know if the feature is supported” is [added or not added] for FG13-15/15a**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 ignaling from location server to gNB related to this FG? If no, then location server doesn’t need to know. |
| Moderator (NTT DOCOMO) | Further discussion on the need for LMF to know seems necessary. I assume other parts of the proposal are acceptable to all. |
| CATT | We prefer to let location server to know. In our point of view, if the FG of Simultaneous SRS transmission for intra-band CA is known by LMF, more information will be benefit for LMF. In addition, we would like to ask what are the disadvantages of supporting LMF to know this information. Huawei comments to worry on over-exposure of UE radio capability to core network as core network already has UE permanent ID, but this information is known by core network, not base stations, we cannot understand why it is a problem indicated by Huawei in the above comments. |
| Huawei/HiSilicon | Reply to CATT  Please refer to the comment in FG13-8 series. |

Based on the above feedbacks, following agreements were made.

**Agreements:**

* **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 ignalling”**
* **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 ignalling”**
* **FFS: Note “Need for location server to know if the feature is supported” is [added or not added] for FG13-15/15a**

### **Updated FL proposal 13:**

* **Note “Need for location server to know if the feature is supported” is added for FG13-15/15a**

Companies are encouraged to discuss further on FFS points in the above agreements.

|  |  |
| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | We do not think this will help anything on recommendation from the location server, at least for this release. |
| Nokia/NSB | Agree with FL proposal |
| MTK | Support HW’s view |
| Qualcomm | Keep the note |
| Moderator (NTT DOCOMO) | More inputs from other companies are necessary. |
| Huawei/HiSilicon | We do not think this capability is useful at LMF, as it is always gNB to determine the SRS configuration in case of CA. LMF cannot make any recommendation with this capability whatsoever. |
| MTK | Agree with HW. No need to add the note |
| CATT | We prefer to let the LMF know them. |
| Moderator (NTT DOCOMO) | Based on the discussion so far,   * Support adding the note: Qualcomm, Nokia, NSB, CATT * Support not adding the note: Huawei, HiSi, MediaTek   Suggestion from moderator is to add the note with bracket for now. |
| Huawei/HiSilicon | The proponents have not addressed the concern that we raised. What the different action is at LMF toward different UE capabilities (e.g one UE supporting a FG, another onother UE not supporting this FG), is unclear at all. It is always gNB that allocates the SRS resources on SCells.  We also have concern that by agreeing all this, UE is mandated to report those components to LMF; because if UE does not, LMF would consider UE not supporting it. Please also refer to our clarification in 2.14 (copied below). There could be the case that UE simply does not want to report those capabilities to LMF, while UE still supports it.   |  | | --- | | 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. | |

## 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 apabiliti 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 apabilitieson” 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. |
| Moderator (NTT DOCOMO) | It seems FL proposal 14 is acceptable to all. |
| CATT | We cannot support FL proposal 14.  Since whether the note “Need for location server to know” is removed or kept is still on discussion in separated FGs, we prefer to discuss this issue in each FG one by one. |
| Huawei/HiSilicon | Reply to CATT,  Please refer to our comments in FG13-8 series. |
| Qualcomm | We don’t agreed. The SRS capabilities need to be sent to the LMF . The reasons:   * LMF recommends a SRS; spatial relation, pathloss reference. Even though gNB decides, LMF should be able to make a good recommendation * And if UE SRS apabilities are not “good enough”, LMF may not use an UL positioning method at all * Without capabilities, it would be an try-and-error approach, which adds just unnecessary delay in case of UE SRS apabilities are not “good enough” |
| Huawei/HiSilicon | We disagree with QC’s argument, in that   1. RAN2 only agrees spatial relation recommendation from LMF, not pathloss. So this entire pathloss feature reported to LMF is not valid. Regarding spatial relation, we think any spatial relation toward the serving gNB can simply be decided by the serving gNB, and thus no recommendation from LMF is needed. In addition, we have the corresponding prerequisite FGs of FG13-10d and FG13-10e being FG13-10 and FG13-10b, respectively. 2. We do not think this is a valid point on “good enough” UE SRS capabilities. LMF has no idea of Rel-15 SRS capability, but can still instigate UL positioning based on Rel-15 SRS. We can accept a single bit for each of the following new feature groups dedicated for SRS capability exposure to LMF    * FG13-xx: Support of periodic SRS for positioning: Reported per band    * FG13-xx: Support of semi-persistent SRS for positioning: Reported per band   So that LMF has better knowledge of UE capability.   1. Even with the capability, there will be trial-and-error approach.   Let’s assume that LMF can recommend the number of SRS resources and number of SRS resource sets to the serving gNB, which we don’t think NRPPa supports now. I know Ericsson is proposing Q-SRS in RAN3, but it is not discussed yet. As LMF does not know the current CA configuration nor the Scell activation status, LMF does not know   * + Based on which band combination the SRS resource capability should be.   + On which Scell the corresponding SRS resources and SRS resource sets are requested   There will be trial and error, as event the commendation should be well accommodated by gNB based on the radio resource; let alone NO SRS frequency information is included the NRPPa message POSITIONING INFORMATION REQEUST.  We think UE capability exposure to LMF should be discussed along with NRPPa POSITIONING INFORMATION REQUEST enhancement so that there is clear utilization of such capability and LMF, which we do not think is likely in Rel-16. Suggest to discuss that in Rel-17 if needed. |
| MTK | Agree with HW’s view |
| Qualcomm | We disagree that the spatial relation should be decided by the serving gNB. If RAN2 has agreed only to spatial relation and not pathloss, we should send an LS and tell them that pathloss should be possible to be recommended. Rel-15 SRS is a “best effort” SRS. It is transparent operation. Rel-16 SRS should be much better than that. Doing “trial-error”, and endorsing such a suboptimal behavior is not acceptable. HW is bringing up issues that RAN2/RAN3 might have based on current agreements. Lets tell them to fix them, than impede the progress in RAN1, only because RAN2/RAN3 are going a bit slower than us. All SRS for positioning capabilities shall be reported to the LMF, as all the PRS capabilities are reported to the LMF. |
| Moderator (NTT DOCOMO) | More inputs from other companies are necessary. |
| Huawei/HiSilicon | Reply to QC:  gNB determination of spatial relation based on recommendation from LMF is agreed in RAN2#109b. Why are you saying you cannot agree with RAN2 agreement in RAN1?  Agreements:  Spatial relation of SRS is recommended by the LMF and decided by the gNB. It is up to gNB implementation whether to follow the LMF recommendation. The gNB informs the LMF of its decision.  UE does not report RSRP of DL-PRS in RRC procedures for SRS configuration.  Keep the current SSB configuration for the DL-only positioning in the LPP message.  Keep the current configuration of SSB in RRC for UL-only positioning. This means that the RRC configuration can carry the full SSB configuration or SSB index and PCI.  For the assistance information in NRPPa for SSB configuration for UL-only positioning, it should include both TF configuration and SSB index in the NRPPa message.  Not sure it is good to laise RAN2 on an issue RAN1 has not ever discussed.  HW was very positive on supporting those procedures to enable LMF to utilize the UE SRS capability, including UE reporting its SCell list to LMF, and UE reporting its UL CA configuration to LMF, which was dismissed in RAN2. It is after the reality check that we think it is too late to introduce this type of enhancement, simply because the driving WG (RAN1) is not responsible for spec maintanence (RAN3) to enable this feature.  LMF does not have UE UL CA configuration, and LMF cannot make a proper recommendation of SRS on any of the SCells.  LMF cannot ultilize the pathloss feature, as RAN2 did not discuss it in Rel-16.  RAN2 and RAN3 are indeed a bit slower than RAN1, yet RAN1 refused to provide input to RAN2/RAN3 to facilitate their discussion. Note that we have less than a month before Rel-16 ASN.1 freeze according to the current schedule.  Based on our evaluation, we think only the following FGs (each with single-bit capability signalling) is needed at LMF   1. Support of periodic SRS for positioning 2. Support of semi-persistent SRS for positioning 3. [Support of aperiodic SRS for positioning] (subject to RAN3 feasibility check) 4. Support of spatial relation of SRS for positioning based on SSB from non-serving cells 5. Support of spatial relation of SRS for positioning based on PRS from non-serving cells. |
| Qualcomm | Reply to HW: I am saying something very simple: Why would only spatial relation be recommended and not path-loss reference when both of them can be from neighboring cell? RAN2 should update the above agreement and my understanding is that this will be discussed also. Pathloss measurement cannot be decided from the serving gNB, exacty because the serving gNB does not know about the pathloss reference from neighbring gNB. **My understanding also is that the above agreement does NOT say that pathloss reference cannot be recommended, and there are proposals to fix the agreement this meeting.** In Ran1, also we make wrong agreements and we update them also.  So, from RAN1 perspective, the path-loss capabilities need to be reported, along with the P/SP/AP SRS resources, and the Multi-RTT capabilities (e.g. inter vs intra frequnency), etc. For example, the DL PRS band is decided by the LMF. If the UL SRS band is decided by the serving gNB, and the LMF does not know whether the UE supports inter-frequency M-RTT, how would the system work? It is much easier, rather than debating one by one, to say all are reported and then RAN2/RAN3 will fix their issues.  You are bringing up that the NRPPa POSITIONING INFORMATION REQUEST is rather limited now. Sure, this is something that RAN3 need to fix, and not the other way around (that is Ran1 progress to be delayed because Ran3 progress is slow.  Overall, if RAN1 agrees to not report some capabilities, then RAN2/Ran3 will not do the work to fix the issue. This is bad. RAN1 will do the job that is needed from it, as the the lead WG working in NR Positioning, and then let RAN2/Ran3 will do their part. In the worst case, the capabilities would not be used in Rel-16 if Ran2/3 do not fix their problem. |
| Huawei/HiSilicon | For FG13-10 series, regarding this capability exposure to LMF, I suggest to leave it up to RAN2 to discuss, because in RAN1 we can only agree that is reported to gNB, which is small loop, and gNB can further take actions on this capability. Reporting to LMF, would require additional signaling support between LMF and serving gNB, which is a big loop and thus may not be appropriate to discuss in RAN1. As RAN2 introduced this feature of spatial relation recommendation from LMF to the serving gNB, RAN2 can further discuss pathloss recommendation, and decide whether to include that capability to LMF to facilitate the pathloss recommendation. Functionality-wise, gNB has the UE capability, gNB receives the spatial relation recommendation per SRS resource in a SRS resource set presumably, and gNB can work out which spatial relation RS will be allocated for the pathloss reference for the entire SRS resource set.  For FG13-8 series, this is reported per FS, which is dedicated IE name in RRC. To include this in LPP, UE will have to report   * All supported band combinations, and in each supported band combinations   + The numbers for each band.   + Those numbers include very specific RAN resource management, e.g. number of resources per BWP, number of resources per slot, number of resources including MIMO SRS and positioning SRS, etc. which LMF cannot decide when it comes resource allocation.   Further LMF does not know which band combination is configured to the UE, nor does LMF know which SCell is activated (as QC explained in RAN2 that SCell can be rather dynamic). How could LMF ultilize this jumbo capability? A lite version of whether UE supports periodic/SP/[AP] SRS for positioning would be sufficient.  If there is a strong need for LMF know the entire SRS capability, either we can enhance it in Rel-17, or we can liase CT4 on UE radio capability transfer between AMF and LMF. |
| MTK | We share similar view as HW. We think only the following FGs (each with single-bit capability signalling) is needed at LMF   * Support of periodic SRS for positioning * Support of semi-persistent SRS for positioning * Support of aperiodic SRS for positioning * Support of spatial relation of SRS for positioning based on SSB from non-serving cells * Support of spatial relation of SRS for positioning based on PRS from non-serving cells   In our understanding, these items are for LMF to know the UE’s SRS transmitting capability, so that LMF knows UE can support UL-related positioning and make recommendation to gNB for configuring UE’s SRS resources.    In LPP 37.355, the power of SSB and PRS are not optional information. Thus, there is no need for LMF to know whether UE supports FG13-9 series.  We don’t understand what LMF can do if LMF knows whether UE supports FG13-9 series. |
| LG | We prefer that the recommendation of path-loss reference by location server could be possible, but we symphasize the HW’s view since it is not possible based on the current agreement. However, at least for spatial relation information for neighbour cell and serving cell should be known to location server, since the recommended beam information by location server could be different from by gNB since the location server has timing measurement information. For this FL’s proposal, we propose to add FG 13-10, FG 13-10a, and 13-10b. |

1. Conclusion

Agreements:

* FFS text in components of FG13-1 is removed
* Notes for component 3 of FG13-1 is moved to Note column
* ~~FFS: additional candidate value(s) of component 3 (e.g., 6, 32)~~
* ~~FFS: Add additional component “max number of positioning frequency layer per band”~~
* ~~FFS: Add 48 as candidate value of component 4 of FG13-1 and other values in brackets are removed~~
* ~~FFS: Change “X%” to “30%” for FG13-1 (depending on [101-e-NR-Pos-01])~~
* Need for the gNB to know if the feature is supported is “No” for FG13-1

Agreements:

* Add N=6 and N=32 as additional candidate values of component 3
* ~~FFS: Add additional component “max number of positioning frequency layer per band”~~
* Add 6, 24 and 48 as candidate values of component 4 of FG13-1

**Agreements:**

* **A new FG for max number of positioning frequency layers UE supports across all positioning methods across all bands is introduced**
  + **Values = {1, 2, 3, 4}**
  + **Type of this FG is per UE**
* **Change “X%” to “30%” for FG13-1**

**Agreements:**

* **FG13-2 is restructured as below**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 TRPs across all positioning frequency layers per UE.   Values = {[3], 6, 12, 16, 24, 32, 64, 128, 256}   1. Max number of positioning frequency layers UE supports   Values = {1, 2, 3, 4} | 13-1 | No | N/A |  | Per UE |
| 13-2a | DL PRS Resources for DL AoD on a band | 1. Max number of DL PRS Resources per DL PRS Resource Set   Values = {2, 4, 8, 16, 32, 64}  Note: 16, 32, 64 are only applicable to FR2 bands   1. Max number of DL PRS Resources per positioning frequency layer.   Values = {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: 6 is only applicable to FR1 bands | 13-1 | No | N/A |  | Per band |
| 13-2b | DL PRS Resources for DL AoD on a band combination | 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}  Note this is reported for FR1 only BC.   1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.   Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC   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}  Note this is reported for BC containing FR1 and FR2 bands   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, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands | 13-1 | No | N/A |  | Per BC |

**Agreements:**

* **FG13-3 is restructured as below**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 13-3 | DL PRS Resources for DL-TDOA | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE.   Values = {1, 2}   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 positioning frequency layers UE supports   Values = {1, 2, 3, 4} | 13-1 | No | N/A |  | Per UE |
| 13-3a | DL PRS Resources for DL-TDOA on a band | 1. Max number of DL PRS Resources per DL PRS Resource Set   Values = {1, 2, 4, 8, 16, 32, 64}  Note: 16, 32, 64 are only applicable to FR2 bands   1. Max number of DL PRS Resources per positioning frequency layer.   Values = {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: 6 is only applicable to FR1 bands | 13-1 | No | N/A |  | Per band |
| 13-3b | DL PRS Resources for DL-TDOA on a band combination | 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}  Note this is reported for FR1 only BC.   1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.   Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC   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}  Note this is reported for BC containing FR1 and FR2 bands   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, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands | 13-1 | No | N/A |  | Per BC |

**Agreements:**

* **FG13-4 is restructured as below**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 13-4 | DL PRS Resources for Multi-RTT | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE.   Values = {1, 2}   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 positioning frequency layers UE supports   Values = {1, 2, 3, 4} | 13-1 | No | N/A |  | Per UE |
| 13-4a | DL PRS Resources for Multi-RTT on a band | 1. Max number of DL PRS Resources per DL PRS Resource Set   Values = {1, 2, 4, 8, 16, 32, 64}  Note: 16, 32, 64 are only applicable to FR2 bands   1. Max number of DL PRS Resources per positioning frequency layer.   Values = {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: 6 is only applicable to FR1 bands | 13-1 | No | N/A |  | Per band |
| 13-4b | DL PRS Resources for Multi-RTT on a band combination | 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}  Note this is reported for FR1 only BC.   1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.   Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC   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}  Note this is reported for BC containing FR1 and FR2 bands   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, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands | 13-1 | No | N/A |  | Per BC |

Agreements:

* ~~FFS: 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”

**Agreements:**

* **Type of FG13-5 is “Per UE”**
  + **Need of FDD/TDD differentiation is “No”**
  + **Need of FR1/FR2 differentiation is “Yes”**
* **Add a note “the number of RSRP measurement on a particular band is also upper bounded by the number of resources per set supported by UE reported per band”**

Agreements:

* “RSTD/[RSRP]” in FG name of FG13-6 is removed
* The component 1 and 2 of FG13-6 are kept (FFS: add “maximum number”)
* FFS: 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”

**Updated FL proposal 6:**

* **Type of FG13-6 is “Per UE”**
  + **Need of FDD/TDD differentiation is “No”**
  + **Need of FR1/FR2 differentiation is “Yes”**
* **Add a note “the number of RSTD/RSRP measurement on a particular band is also upper bounded by the number of resources per set supported by UE reported per band”**

Agreements:

* 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
* ~~FFS: Type of FG13-8/8a/8b is “Per FS”~~
* ~~FFS: Note is [removed or kept]~~

**Agreements:**

* **Type of FG13-8/8a/8b is “Per FS”**
  + **Add a note “Per FS is selected because similar capability was reported per FS (in FeatureSetUplink) in Rel-15”**
* **Note for FG13-8/8a/8b is removed**

Agreements:

* 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
* FFS: Note is [removed or kept]

**Updated FL proposal 8:**

* **Note for FG13-9/9a/9b/9c is removed**

Agreements:

* 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
* FFS: Note is [removed or kept]

**Updated FL proposal 9:**

* **Note for FG13-10d/10e is kept**
* **Note for FG13-10/10a/10b/10c is removed**
* **Add “in the same band” in component description for 13-10/10a/10b/10c/10d/10e**

Agreements:

* FFS: 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
* FFS: 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

**Updated FL proposal 10:**

* **FG13-11a is kept with following components.**
  + **1. Support of measurements derived on DL PRS resource/resource sets which are in different positioning frequency layers**
  + **2. Support of measurements derived on PRS and SRS which may be in a different band**
* **Type of FG13-11a is “Per band”**

**FL proposal 11:**

* **Type of FG13-13 is “Per UE”**
  + **Need of FDD/TDD differentiation is “No”**
  + **Need of FR1/FR2 differentiation is “Yes”**

**FL proposal 12:**

* **Type of FG13-14 is “Per UE”**
  + **Need of FDD/TDD differentiation is “No”**
  + **Need of FR1/FR2 differentiation is “Yes”**

Agreements:

* 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”
* FFS: Note “Need for location server to know if the feature is supported” is [added or not added] for FG13-15/15a

**Updated FL proposal 13:**

* **Note “Need for location server to know if the feature is supported” is added for FG13-15/15a**

**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]

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |