**3GPP TSG RAN WG1 #122 R1-2506226**

**Bengaluru, India, Aug 25th – 29th, 2025**

**Agenda Item: 9.1**

**Source: Moderator (AT&T)**

**Title: Summary of UE features for AI/ML for NR Air Interface**

**Document for:** **Discussion/Decision**

# Introduction

This document presents the summary of email discussion [122-R19-UE\_features] during RAN1 #122. According to the Chair’s Notes:

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| [122-R19-UE\_features] Email discussion on Rel-19 UE features – Ralf (AT&T), Naoya (DOCOMO), Ralf (AT&T)   * To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc |

The following was discussed during RAN1 #122 within the scope of [122-R19-UE\_features]. All proposals are based on the latest RAN1 UE features list for Rel. 19 in [1].

# Summary of Contributions Submitted to RAN1 #122

The following is the moderator’s summary of contributions submitted to RAN1 #122 in this agenda item.

## Specification support for beam management

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| 58. NR\_AIML\_air | 58-0-1 | CSI report framework for UE-side inference | 1. Maximum number of APUs for all types of UE-sided inference for CSI report(s) for simultaneously in a CC  2. Maximum number of APUs for all types of UE-sided inference for CSI report(s) simultaneously across all CCs | FFS | yes | n/a | Maximum number of APUs for UE-sided inference is unknown to the network | FFS | FFS | FFS | FFS | Component 1 candidate values: FFS  Component 2 candidate values: FFS | Optional with capability signalling |

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| Company | Summary |
| Ericsson [2] | During RAN1#120bis, RAN1 agreed to support several features related to AI/ML beam management. It was however only agreed for NW-sided model that the feature group naming should not include a possible purpose (“Increased number of reported RSs for beam management ~~[for NW-sided model inference]”~~).  Including the purpose of a feature is unprecedented in RAN1 and should be avoided both for NW and UE-sided model.   1. The purpose should not be part of any feature group naming. Hence aligned with the removal “for NW-sided model inference”, remove “for UE-sided model inference” across all features.   The FG 58-0-1 needs to be updated to support the following proposed way forward was endorsed in RANP #108.   |  | | --- | | Proposal   * A UE can report support for N (up to 2) AI/ML PU pools for AI/ML features   - For each of the N AI/ML PU pools, UE reports the maximum number of simultaneous AI/ML PUs, respectively.  - If N = 2, for each AI/ML use case feature, UE reports which AI/ML PU pool it belongs to. |  1. Update FG 58-0-1 for CSI report framework for UE-side inference to support UE capable of one or two APU pools. |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-0-1 | CSI report framework for UE-side inference | 1. Maximum number of additional CPU pools for simultaneous CSI calculations  2. Maximum number of CPUs for each supported additional CPU pool for all types of UE-sided inference for CSI report(s) for simultaneously in a CC  3. Maximum number of CPUs for each supported additional CPU pool for all types of UE-sided inference for CSI report(s) simultaneously across all CCs | 2-35 | yes | n/a | Maximum number of APUs for UE-sided inference is unknown to the network | FFS | N/A | N/A | N/A | Component 1 candidate values: {1,2}  Component 2 candidate values: FFS  Component 3 candidate values: FFS | Optional with capability signalling | |
| CATT/CICTCI [4] |  |
| Huawei/HiSilicon [5] | **Components for 58-0-1**   * Component 1/2: In RAN#108 meeting, the following proposal has been endorsed where UE can report support for N (up to 2) AI/ML PU pools for AI/ML features. For each of the N AI/ML PU pools, UE reports the maximum number of simultaneous AI/ML PUs, respectively. In other words, UE can report the maximum number of up to 2 types of APU (denoted as APU1 and APU2). In addition, when both APU1 and APU2 are reported, UE reports the AI/ML feature(s) that each type of APU can be used for.  |  | | --- | | Proposal   * A UE can report support for N (up to 2) AI/ML PU pools for AI/ML features   + For each of the N AI/ML PU pools, UE reports the maximum number of simultaneous AI/ML PUs, respectively.   + If N = 2, for each AI/ML ~~use case~~ feature, UE reports which AI/ML PU pool it belongs to. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-0-1 | CSI report framework for UE-side inference | 1. The feature(s) applied with APU1  1a. Maximum number of APU1s for ~~all types of~~ UE-sided inference for CSI report(s) for simultaneously in a CC  1b~~2~~. Maximum number of APU1s for ~~all types of~~ UE-sided inference for CSI report(s) simultaneously across all CCs  2. The feature(s) applied with APU2  2a. Maximum number of APU2s for UE-sided inference for CSI report(s) for simultaneously in a CC  2b. Maximum number of APU2s for UE-sided inference for CSI report(s) for simultaneously across all CCs | FFS | yes | n/a | Maximum number of APUs for UE-sided inference is unknown to the network | FFS | FFS | FFS | FFS | Component 1 candidate values: ~~FFS~~  {UE-side beam prediction, UE-side CSI prediction, UE-side beam prediction and UE-side CSI prediction }  Component 1a candidate values: {from 1 to 8}  Component 1b candidate values:  {from 5 to 32}  Component 2 candidate values: ~~FFS~~  {UE-side beam prediction, UE-side CSI prediction}  Component 2a candidate values:  {from 1 to 8}  Component 2b candidate values: {from 5 to 32}  Note: UE can report Component 1,1a,1b only, or report both Component 1,1a,1b and 2,2a,2b.  Note: The features applied with APU1 and APU2 are not overlapped. | Optional with capability signalling | |
| Vivo [6] |  |
| Xiaomi [7] |  |
| ZTE Corporation/Sanechips [8] | Regarding FG58-0-1, based on our understanding, it can apply similar design as the legacy CPU. For the legacy CPU, the following value ranges are applied.   * *simultaneousCSI-ReportsAllCC INTEGER (5..32)* * *simultaneousCSI-ReportsPerCC INTEGER (1..8)*   Thus, the same value range can be applied for the APU here.  ***Proposal 2****: Regarding FG58-0-1, the value range for Component 1 (APU per CC) is (1..8), and the value range for Component 2 (APU for all CC) is (5..32).* |
| Samsung [9] |  |
| Ofinno [10] |  |
| OPPO [11] |  |
| LG Electronics [12] |  |
| Apple [13] | In RAN Plenary 108, the proposal in RP-251823 (Revision of RP-251658) was endorsed for AI/ML PU sharing, which extends the one AI/ML PU pool to maximum of two AI/ML PU pools.   * + A UE can report support for N (up to 2) AI/ML PU pools for AI/ML features     - For each of the N AI/ML PU pools, UE reports the maximum number of simultaneous AI/ML PUs, respectively.     - If N = 2, for each AI/ML feature, UE reports which AI/ML PU pool it belongs to.   Based on the agreement, the previous UE feature 58-0-1 is updated as proposed.  **Proposal 1-1: Update the UE FGs 58-0-1 to capture maximum two APU agreement.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-0-1 | CSI report framework for UE-side inference | 1. Number of APU pools N.  2. Maximum number of APUs in each APU pool ~~for all types of UE-sided inference~~ for CSI report(s) ~~for~~ simultaneously in a CC  3. Maximum number of APUs in each APU pool ~~for all types of UE-sided inference~~ for CSI report(s) simultaneously across all CCs | FFS | yes | n/a | Maximum number of APUs for UE-sided inference is unknown to the network | FFS | FFS | FFS | FFS | Component 1 candidate values: 1, 2  Component 2 candidate values:  Up to 8  Component 2 candidate values:  Up to 32 | Optional with capability signalling | |
| CMCC [14] |  |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-0-1 | CSI report framework for UE-side inference | 1. Maximum number of APUs for all types of UE-sided inference for CSI report(s) for simultaneously in a CC  2. Maximum number of APUs for all types of UE-sided inference for CSI report(s) simultaneously across all CCs | FFS | yes | n/a | Maximum number of APUs for UE-sided inference is unknown to the network | FFS | FFS | FFS | FFS | Component 1 candidate values: INTEGER (0..8)  Component 2 candidate values: INTEGER (0..32) | Optional with capability signalling | |
| NTT DOCOMO, INC. [16] | At the RAN1#121 meeting, FG 58-0-1 is introduced for all CSI-related AI/ML use cases based on the agreements about the APU occupation. At the RAN #108 meeting, the following were agreed to allow UE reporting up to 2 resource pools for UE inference with AI/ML.   |  | | --- | | A UE can report support for N (up to 2) AI/ML PU pools for AI/ML features   * For each of the N AI/ML PU pools, UE reports the maximum number of simultaneous AI/ML PUs, respectively. * If N = 2, for each AI/ML use case feature, UE reports which AI/ML PU pool it belongs to. |   To accommodate this agreement, FG 58-0-1 should be updated to allow report the number of APU pools and the maximum APU resources for each pool. Since for 5GA, the APU pools are only for CSI-related use cases, the prerequisite of FG 58-0-1 can be FG 2-32, the basic CSI feedback.  For CSI-related use cases, UE will also report the APU occupation for the CSI report configuration that requires UE inference, e.g., the following for AI/ML beam management.   |  | | --- | | Agreement  For UE-side model, for AI/ML based beam management for BM-Case 1 and BM-Case 2, for processing of a CSI report for inference,   * For PU occupancy, for the number of AI/ML PU (OAPU) and/or legacy CPU (OCPU) are occupied,   + OAPU= 0 or X1/X2 is reported by UE in UE capability report for BM-Case 1 and BM-Case 2 respectively   + OCPU=0 or Y1/Y2 is reported by UE in UE capability report for BM-Case 1 and BM-Case 2 respectively   + Note: Detailed values of X1/X2 and Y1/Y2 can be further discussed in UE feature.   + Note: Combination of OAPU= 0 and OCPU=0 is not allowed   + Note: if any of the unoccupied PU cannot satisfy the corresponding required PU by the CSI report, the CSI report will follow the legacy behavior of exceeding the CPU limit, neither of the PUs are occupied |   When both maximum number of APU and APU occupation per configuration are reported by UE, there will be no common understanding about the meaning of one unit for APU between the NW and UE. To alleviate this issue, we suggest limiting the range of the maximum number of APU and candidate values for APU occupation reporting, with which the NW can have some understanding about the AI/ML capability of a UE.  **Proposal 1: Update FG 58-0-1 as follows.**   * **Add number of APU pools and update the corresponding parts for the reporting.** * **The prerequisite is FG 2-32.** * **The range of the maximum number of APUs for each APU pool is [0, 8].**  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-0-1 | CSI report framework for UE-side inference | 1. Number of APU pools.  2. Maximum number of APUs for each APU pool for all types of UE-sided inference for CSI report(s) for simultaneously in a CC  3. Maximum number of APUs for each APU pool for all types of UE-sided inference for CSI report(s) simultaneously across all CCs | 2-32 | yes | n/a | Maximum number of APUs for UE-sided inference is unknown to the network | Per UE | No | No |  | Component 1 candidate values: {0, 1, 2}  Component 2 candidate values:  [0, 8]  Component 3 candidate values: [0, 8] | Optional with capability signalling | |

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| 58. NR\_AIML\_air | 58-1-1 | Increased number of reported RSs for beam management | 1. Support of reporting format for L1-RSRP measurements not including CRI/SSBRI other than one for the largest measured L1-RSRP in a reporting instance, if the number of reported L1-RSRPs is equal to the size of the measurement resource set.  2. Support of reporting format for L1-RSRPs and corresponding beam information of Top M beam(s) with largest M measured value(s) of L1-RSRP(s) of a measurement resource set, where M is configured by gNB, if the number of reported L1-RSRPs is smaller than the size of the measurement resource set  3. Maximum number of M reported RSs, M>4 | FFS | yes | n/a | Increased number of reported beams for beam management is not supported | FFS | FFS | FFS | FFS | Component 3 candidate values: {6,8} | Optional with capability signalling |

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| Company | Summary |
| Ericsson [2] |  |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-1 | Increased number of reported RSs for beam management | 1. Support of reporting format for L1-RSRP measurements not including CRI/SSBRI other than one for the largest measured L1-RSRP in a reporting instance, if the number of reported L1-RSRPs is equal to the size of the measurement resource set.  2. Support of reporting format for L1-RSRPs and corresponding beam information of Top M beam(s) with largest M measured value(s) of L1-RSRP(s) of a measurement resource set, where M is configured by gNB, if the number of reported L1-RSRPs is smaller than the size of the measurement resource set  3. Maximum number of M reported RSs, M>4 | FFS, | yes | n/a | Increased number of reported beams for beam management is not supported | FFS | FFS | FFS | FFS | Component 3 candidate values: {6,8} | Optional with capability signalling | |
| CATT/CICTCI [4] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-1 | Increased number of reported RSs for beam management | 1. Support of reporting format for L1-RSRP measurements not including CRI/SSBRI other than one for the largest measured L1-RSRP in a reporting instance, if the number of reported L1-RSRPs is equal to the size of the measurement resource set~~.~~  ~~2. Ss~~upport of reporting format for L1-RSRPs and corresponding beam information of Top M beam(s) with largest M measured value(s) of L1-RSRP(s) of a measurement resource set, where M is configured by gNB, if the number of reported L1-RSRPs is smaller than the size of the measurement resource set  3. Maximum number of M reported RSs, M>4 | FFS | yes | n/a | Increased number of reported beams for beam management is not supported | FFS | FFS | FFS | FFS | Component 3 candidate values: {6,8} | Optional with capability signalling | |
| Huawei/HiSilicon [5] |  |
| Vivo [6] |  |
| Xiaomi [7] |  |
| ZTE Corporation/Sanechips [8] |  |
| Samsung [9] |  |
| Ofinno [10] |  |
| OPPO [11] |  |
| LG Electronics [12] |  |
| Apple [13] |  |
| CMCC [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] | At the previous RAN1 meetings, agreements were made about FG for increasing the number of beams in L1-RSRP reporting. For this feature, there is no strong motivation to introduce finer granularity, such as per BC/FC/FCPC. Unless any justification is brought, per UE (or per band) should be sufficient. Also, the prerequisite of this FG can be FG 2-24.  **Proposal 2: Update FG 58-1-1 as follows.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-1 | Increased number of reported RSs for beam management | 1.Support of reporting format for L1-RSRP measurements not including CRI/SSBRI other than one for the largest measured L1-RSRP in a reporting instance, if the number of reported L1-RSRPs is equal to the size of the measurement resource set.  2. Support of reporting format for L1-RSRPs and corresponding beam information of Top M beam(s) with largest M measured value(s) of L1-RSRP(s) of a measurement resource set, where M is configured by gNB, if the number of reported L1-RSRPs is smaller than the size of the measurement resource set  3. Maximum number of M reported RSs, M>4 | 2-24 | yes | n/a | Increased number of reported beams for beam management is not supported | Per UE | No | No |  | Component 3 candidate values: {6, 8} | Optional with capability signalling | |

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| 58. NR\_AIML\_air | 58-1-2 | UE-side beam prediction for BM Case1 [for inference] | 1. Support of beam prediction with reporting of predicted beam index for BM-Case1 [for inference] with UE-side model  3. Maximum number of inference report(s) configured for BM-Case1 per BWP  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  [4. Maximum number of inference report(s) activated for BM-Case1 per BWP]  [4a. Maximum number of inference report(s) activated for BM-Case1 across all CCs]  [5. Maximum number of inference report(s) triggered for BM-Case1 per BWP]  [5a. Maximum number of inference report(s) triggered for BM-Case1 across all CCs]  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  [7. Supported combinations of the number of resources for Set B and the number of resources for Set A]  [7a: Supported maximum number of resources for Set B]  [7b: Supported maximum number of resources for Set A][8. Supported CSI-RS resource types: Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS]  [9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report]  [10. Supported options for performance monitoring for beam case 1 with UE side model]  [11. Supported BM-Case 1 sub-usecase(s): {setB-subset-of-setA, setB-different-from-setA, both}]  12. Supported maximum number of predicted beams in each reporting instanceFFS: whether/how to merge this FG with other FG(s) for performance monitoring and/or data collection | FFS | yes | n/a | UE-side~~d~~ beam prediction for BM Case 1 [for inference] is not supported | FFS | FFS | FFS | FFS | FFS: CPU/AIMLPU related information | Optional with capability signalling |

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| Company | Summary |
| Ericsson [2] | The values of X1/X2/Y1/Y2 need to be addressed to complete the feature. To reduce the complexity for the NW to handle many different combinations of PU occupancies, a limited number of values should be supported. Two unique values for X1/X2/Y1/Y2 are proposed as a starting point, the exact value is based on the estimated complexity for BM-Case 1 and BM-Case2. Given the increased model input/output of BM-Case 2, it likely should have larger complexity.  Furthermore, the following proposed way forward was endorsed in RANP #108.   |  | | --- | | Proposal   * A UE can report support for N (up to 2) AI/ML PU pools for AI/ML features   - For each of the N AI/ML PU pools, UE reports the maximum number of simultaneous AI/ML PUs, respectively.  - If N = 2, for each AI/ML use case feature, UE reports which AI/ML PU pool it belongs to. |   This means that when the UE supports N=2 APU pools, then the APU pool index associated with AI/ML UE feature needs to be included as part of the capability report.   1. For the values of X1/X2 and Y1/Y2, support a limited number of values. Assume X1/X2/Y1/Y2 can take 2 unique values as a starting point. 2. As part of FGs 58-1-2, 58-1-3, 58-1-4, and 58-1-5, introduce APU pool index associated with the FG when 2 APU pools are supported by the UE.   Regarding the values of d and d’, if a large value is supported, the NW might receive outdated predictions at least for BM-Case 1. Moreover, it could occupy the PU resources an extensive amount of time, limiting the NW flexibility to configure other CSI-reports. Our view is that the extension should not support large values of d and d’.   1. For the values of d and d’, do not support large values since it would reduce the usefulness of the predictions, in particular for BM-Case 1, and would limit the NW flexibility to configure other CSI reports.   For the UE-side beam prediction for BM-Case 1 and BM-Case 2, the agreed UE feature definition is almost complete. Only a clarification is needed that the UE should also support the performance monitoring as part of the feature.   1. For components of FG 58-1-2, FG 58-1-3, FG 58-1-4 and FG 58-1-5 in addition to the agreed components, add the component: “Support UE-assisted performance monitoring.” |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-2 | UE-side beam prediction for BM Case1 | 1. Support of beam prediction with reporting of predicted beam index for BM-Case1 with UE-side model  3. Maximum number of inference report(s) configured for BM-Case1 per BWP  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  [4. Maximum number of inference report(s) activated for BM-Case1 per BWP]  [4a. Maximum number of inference report(s) activated for BM-Case1 across all CCs]  [5. Maximum number of inference report(s) triggered for BM-Case1 per BWP]  [5a. Maximum number of inference report(s) triggered for BM-Case1 across all CCs]  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  [  7a: Supported maximum number of resources for Set B  7b: Supported maximum number of resources for Set A  8. Supported CSI-RS resource types: Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS  9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report  10. Support performance monitoring for beam case 1  11. Supported BM-Case 1 sub-usecase(s): {setB-subset-of-setA, setB-different-from-setA, both}  12. Supported maximum number of predicted beams in each reporting instanceFFS: whether/how to merge this FG with other FG(s) for performance monitoring and/or data collection  [13. Indicate the additional CPU pool used for this feature]  [14. Values for CPU occupation in CPU and additional CPU pools] | , 58-0-1 | yes | n/a | UE-side~~d~~ beam prediction for BM Case 1 is not supported | FFS | FFS | FFS | FFS | FFS: CPU/AIMLPU related information  [component 14: Legacy pool = 0 or 1 CPU  Additional pool(s) = 0 or 1 CPU.,  0 & 0 is not valid combination ] | Optional with capability signalling | |
| CATT/CICTCI [4] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-2 | UE-side beam prediction for BM Case1 ~~[~~for inference~~]~~ | 1. Support of beam prediction with reporting of predicted beam index for BM-Case1 ~~[~~for inference~~]~~ with UE-side model  3. Maximum number of inference report(s) configured for BM-Case1 per BWP  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  ~~[4. Maximum number of inference report(s) activated for BM-Case1 per BWP]~~  ~~[4a. Maximum number of inference report(s) activated for BM-Case1 across all CCs]~~  ~~[5. Maximum number of inference report(s) triggered for BM-Case1 per BWP]~~  ~~[5a. Maximum number of inference report(s) triggered for BM-Case1 across all CCs]~~  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[~~7. Supported combinations of the number of resources for Set B and the number of resources for Set A~~]~~  ~~[7a: Supported maximum number of resources for Set B]~~  ~~[7b: Supported maximum number of resources for Set A][8. Supported CSI-RS resource types: Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS]~~  ~~[9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report]~~  ~~[~~10. Supported options for performance monitoring for beam case 1 with UE side model~~]~~  ~~[~~11. Supported BM-Case 1 sub-usecase(s): {setB-subset-of-setA, setB-different-from-setA, both}~~]~~  12. Supported maximum number of predicted beams in each reporting instanceFFS: whether/how to merge this FG with other FG(s) for performance monitoring and/or data collection | FFS | yes | n/a | UE-side~~d~~ beam prediction for BM Case 1 [for inference] is not supported | FFS | FFS | FFS | FFS | FFS: CPU/AIMLPU related information | Optional with capability signalling | |
| Huawei/HiSilicon [5] | **Notation of 58-1-2/58-1-3**  Regarding the notation of the two FGs, there is square bracket on [for inference]. We think [for inference] can be removed, since there is no previous BM UE feature for beam prediction.  In the following, we provide our views to the components.  **58-1-2 components**   * Component 4/4a/5/5a: In legacy FG 2-35, it already incorporates the max number of CSI reports for A-CSI, SP-CSI and P-CSI reports. Regarding AI/ML based CSI reports, the number of AI/ML calculation/memory resources can be reflected by PU mechanism, which will not impact the number of CSI reports. Therefore, we do not support Component 4/4a/5/5a. * Component 7/7a/7b: Component 7 can fully reflect the information of 7a/7b and is more flexible than 7a/7b, e.g., Component 7 can preclude some unreasonable combinations of Set B size and Set A size, e.g., {4, 64}, {24, 32}. Therefore, we prefer to keep Component 7 over 7a/7b. * Component 8/9: OK to support. * Component 10: Can be discussed after the monitoring FG is clear. * Component 11: Not sure whether setB-different-from-setA only refers to wide-to-narrow, or it can also be narrow-to-narrow. Can be further discussed. * Component 13 (new): In RAN1#121 meeting, it has been agreed that for inference for BM-Case 1, legacy timeline is extended by adding an additional delay (d/d’) reported by UE. Since the inference is performed only after receiving CSI-RS/SSB resources, the same inference delay should be added to both Z3 and Z3’, i.e., d=d’. Therefore, we propose that UE reports only one value of additional delay per SCS for both Z3 and Z3’. Considering that for relatively small model size of beam management, the inference delay could be ms level.  |  | | --- | | Agreement  For UE-sided model, regarding a CSI report with *CSI-ReportConfig* for inference for BM-Case1 and BM-Case 2, when applicable, extend legacy Z3/Z3’ to Z3+d/ Z3’+d’, where d and d’ are reported by UE per SCS for BM-Case 1 and BM-Case 2 respectively   * Detailed values of d and d’ can be further discussed in UE feature. |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-2 | UE-side beam prediction for BM Case1 ~~[for inference]~~ | 1. Support of beam prediction with reporting of predicted beam index for BM-Case1 ~~[for inference]~~ with UE-side model  3. Maximum number of inference report(s) configured for BM-Case1 per BWP  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  ~~[4. Maximum number of inference report(s) activated for BM-Case1 per BWP]~~  ~~[4a. Maximum number of inference report(s) activated for BM-Case1 across all CCs]~~  ~~[5. Maximum number of inference report(s) triggered for BM-Case1 per BWP]~~  ~~[5a. Maximum number of inference report(s) triggered for BM-Case1 across all CCs]~~  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[~~7. Supported combinations of the number of resources for Set B and the number of resources for Set A~~]~~  ~~[7a: Supported maximum number of resources for Set B]~~  ~~[7b: Supported maximum number of resources for Set A]~~  ~~[~~8. Supported CSI-RS resource types: Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS~~]~~  ~~[~~9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report~~]~~  [10. Supported options for performance monitoring for beam case 1 with UE side model]  [11. Supported BM-Case 1 sub-usecase(s): {setB-subset-of-setA, setB-different-from-setA, both}]  12. Supported maximum number of predicted beams in each reporting instance  13. The number of symbols di introduced for the timeline of inference in addition to legacy Z3/Z3’, where  i is the index of SCS, i=1,2,3,4,5,6 corresponding to 15,30,60,120,480,960 kHz SCS.  FFS: whether/how to merge this FG with other FG(s) for performance monitoring and/or data collection | FFS | yes | n/a | UE-side~~d~~ beam prediction for BM Case 1 ~~[for inference]~~ is not supported | FFS: CPU/AIMLPU related information  FFS: Component 13 candidate values | Optional with capability signalling | |
| Vivo [6] | For FG 58-1-2, it is acceptable to retain the purpose as "for inference", since the UE inference feature is designated exclusively for this function and cannot be repurposed for other purposes such as data collection or monitoring.   1. For components of FG 58-1-2, FG 58-1-3, FG 58-1-4 and FG 58-1-5, support to retain the purpose as "for inference".   Components 7a and 7b of FG 58-1-2 and FG 58-1-4 offer a superior alternative to component 7. Within the UE capability reporting framework, it is mandatory that the UE declares its maximum capability. Critically, the adoption of component 7 would exponentially increase the combinatorial complexity of Set B and Set A dimensions, resulting in prohibitive signaling overhead. By leveraging components 7a and 7b, the UE can actively validate during the applicable report procedure whether the Set B size or Set A size within inference configuration parameters conforms to the deployed AI models. Concurrently, the minimum capability threshold of Set B must be reported to the network to prevent invalid configuration attempts and optimize resource allocation.   1. For components of FG 58-1-2 and FG 58-1-4 in addition to the agreed components:  * **Support 7a: supported maximum number of resources for Set B + 7b: supported maximum number of resources for Set A** * **Support 7c: supported minimum number of resources for Set B**  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-2 | UE-side beam prediction for BM Case1 ~~[for inference]~~ for inference | 1. Support of beam prediction with reporting of predicted beam index for BM-Case1 ~~[for inference]~~ for inference with UE-side model  3. Maximum number of inference report(s) configured for BM-Case1 per BWP  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  [4. Maximum number of inference report(s) activated for BM-Case1 per BWP]  [4a. Maximum number of inference report(s) activated for BM-Case1 across all CCs]  [5. Maximum number of inference report(s) triggered for BM-Case1 per BWP]  [5a. Maximum number of inference report(s) triggered for BM-Case1 across all CCs]  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[7. Supported combinations of the number of resources for Set B and the number of resources for Set A]~~  7a: Supported maximum number of resources for Set B  7b: Supported maximum number of resources for Set A  7c: Supported minimum number of resources for Set B  [8. Supported CSI-RS resource types: Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS]  [9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report]  [10. Supported options for performance monitoring for beam case 1 with UE side model]  [11. Supported BM-Case 1 sub-usecase(s): {setB-subset-of-setA, setB-different-from-setA, both}]  12. Supported maximum number of predicted beams in each reporting instanceFFS: whether/how to merge this FG with other FG(s) for performance monitoring and/or data collection | FFS | yes | UE-side~~d~~ beam prediction for BM Case 1~~[for inference]~~ for inference is not supported | FFS: CPU/AIMLPU related information | |
| Xiaomi [7] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-2 | UE-side beam prediction for BM Case1 for inference | 1. Support of beam prediction with reporting of predicted beam index for BM-Case1 for inference with UE-side model  3. Maximum number of inference report(s) configured for BM-Case1 per BWP  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  4. Maximum number of inference report(s) activated for BM-Case1 per BWP  4a. Maximum number of inference report(s) activated for BM-Case1 across all CCs  5. Maximum number of inference report(s) triggered for BM-Case1 per PWB  5a. Maximum number of inference report(s) triggered for BM-Case1 across all CCs  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  7. Supported combinations of the number of resources for Set B and the number of resources for Set A  8. Supported CSI-RS resource types for Set A/B: Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS  9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report  11. Supported BM-Case 1 sub-usecase(s): {setB-subset-of-setA, setB-different-from-setA, both}  12. Supported maximum number of predicted beams in each reporting instance  13. Number of occupied CPU  14. Number of occupied APU14a. APU pool index.  FFS: whether/how to report the supported maximum total number of CSI reports across different AI/ML based use-cases  FFS: whether some of components will be reported dynamically instead of as capability  FFS: whether/how to merge this FG with other FG(s) for performance monitoring and/or data collection | FFS | yes | n/a | UE-sided beam prediction for BM Case 1 [for inference] is not supported | FFS | FFS | FFS | FFS | FFS: Further partitioning of this FG based on existing and future agreements  FFS: CPU/AIMLPU related information  FFS: candidate values for Component 12 candidate values: {1, 2, 4} | Optional with capability signalling | |
| ZTE Corporation/Sanechips [8] | Regarding the following component of FG58-1-2, basically, there are two different alternatives to let the UE report the supported combinations of set A and set B. The first one is to report this info via UE capability, while the other one is to report this info via UE applicability report defined by RAN2. These two methods represent two different flexibilities. Typically, reporting supported combinations of the number of RS in set B and Set A via UE capability has less flexibility, while reporting supported combinations of the number of RS in set B and Set A via applicability report has higher flexibility since UE can update the applicability report whenever it has new AI models.  [7. Supported combinations of the number of resources for Set B and the number of resources for Set A]  [7a: Supported maximum number of resources for Set B]  [7b: Supported maximum number of resources for Set A]  Thus, we propose to discuss these two different methods.  ***Proposal 3****: Regarding FG58-1-2, discuss the following two methods to report the supported combinations of number of beams in set A and number of beams in set B considering the flexibility of different methods.*   * *Method.1: Report the supported combinations of the number of resources for Set B and the number of resources for Set A via UE capability.* * *Method.2: Report the maximum number of resources for Set B/Set A via UE capability, and report the supported combinations of the number of resources for Set B and the number of resources for Set A via applicability report.*   Regarding the components of FG58-1-2~FG58-1-5, the “FFS: CPU/AIMLPU related information” can be addressed by allowing the UE to report the occupied CPU and/or AIMLPU.  ***Proposal 4****:* *Regarding the components of FG58-1-2~FG58-1-5, UE reports the occupied CPU and/or AIMLPU.*  Regarding the following component of FG58-1-2, unlike AI CSI prediction, the additional cache overhead for performance monitoring for AI beam prediction at the UE side is not that large. If UE supports UE side AI beam prediction but doesn’t support performance monitoring, network doesn’t know whether the prediction can be trusted or not. Alternatively, network may trigger UE to report measurement results of Set A periodically to check the prediction accuracy, which will negate the overhead reduction of AI beam prediction. Thus, we propose to introduce performance monitoring in the basic UE feature of AI beam prediction.  [10. Supported options for performance monitoring for beam case 1 with UE side model]  ***Proposal 5****: Regarding FG58-1-2, add the following component 10 for performance monitoring.*   * *Component 10: Supported options for performance monitoring for beam case 1 with UE side model* |
| Samsung [9] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-2 | UE-side beam prediction for BM Case1 ~~[for inference]~~ | 1. Support of beam prediction with reporting of predicted beam index for BM-Case1 ~~[for inference]~~ with UE-side model  3. Maximum number of inference report(s) configured for BM-Case1 per BWP  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  [4. Maximum number of inference report(s) activated for BM-Case1 per BWP]  [4a. Maximum number of inference report(s) activated for BM-Case1 across all CCs]  [5. Maximum number of inference report(s) triggered for BM-Case1 per PWB]  [5a. Maximum number of inference report(s) triggered for BM-Case1 across all CCs]  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  [7. Supported combinations of the number of resources for Set B and the number of resources for Set A]  [7a: Supported maximum number of resources for Set B]  [7b: Supported maximum number of resources for Set A]  [8. Supported of periodic CSI-RS resource types for Set A: Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS]  [9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report]  [10. Supported options for performance monitoring for beam case 1 with UE side model]  [11. Supported BM-Case 1 sub-usecase(s): {setB-subset-of-setA, setB-different-from-setA, both}]  12. Supported maximum number of predicted beams in each reporting instance  13. supported number of occupied CPU if *nroftimeinstance-r19* is not configured  14. supported number of occupied APU if *nroftimeinstance-r19* is not configured  15. supported value of d for the relaxation of Z3 timeline if *nroftimeinstance-r19* is not configured  16. supported value of d’ for the relaxation of Z’3 timeline if *nroftimeinstance-r19* is not configured | FFS | yes | n/a | UE-side~~d~~ beam prediction for BM Case 1 ~~[for inference]~~ is not supported | FFS | FFS | FFS | FFS | ~~FFS: CPU/AIMLPU related information~~  Component 12 candidate values: {1, 2, 4}  Component 13 candidate values: FFS  Component 14 candidate values: FFS  Component 15 candidate values: FFS  Component 16 candidate values: FFS | Optional with capability signalling | |
| Ofinno [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-2 | UE-side beam prediction for BM Case1 for inference | 1. Support of beam prediction with reporting of predicted beam index for BM-Case1 for inference with UE-side model  ~~[2. Supported mapping pattern between set B and set A]~~  ~~[~~3. Maximum number of inference report(s) configured for BM-Case1 per BWP~~]~~  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  4. Maximum number of inference report(s) activated for BM-Case1 per BWP  4a. Maximum number of inference report(s) activated for BM-Case1 across all CCs  5. Maximum number of inference report(s) triggered for BM-Case1 per PWB  5a. Maximum number of inference report(s) triggered for BM-Case1 across all CCs  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  ~~FFS: RS type for Set A~~  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  7. Supported combinations of the number of resources for Set B and the number of resources for Set A  ~~FFS: component 7 or component 7a+7b or 7+7a+7b~~  8. Supported of CSI-RS resource types for Set A: Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS  9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report  11. Supported BM-Case 1 sub-usecase(s): {setB-subset-of-setA, setB-different-from-setA, both}  ~~[~~12. Supported maximum number of predicted beams in each reporting instance~~]~~  ~~FFS: whether/how to report the supported maximum total number of CSI reports across different AI/ML based use-cases~~  ~~FFS: whether some of components will be reported dynamically instead of as capability~~  ~~FFS: whether/how to merge this FG with other FG(s) for performance monitoring and/or data collection~~ | FFS | yes | n/a | UE-side~~d~~ beam prediction for BM Case 1 for inference is not supported | FFS | FFS | FFS | FFS | ~~FFS: Further partitioning of this FG based on existing and future agreements~~  FFS: CPU/AIMLPU related information  ~~FFS: candidate values for~~ Component 12 candidate values: {1, 2, 3, 4} | Optional with capability signalling | |
| OPPO [11] |  |
| LG Electronics [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-2 | UE-side beam prediction for BM Case1 [for inference] | 1. Support of beam prediction with reporting of predicted beam index for BM-Case1 [for inference] with UE-side model  3. Maximum number of inference report(s) configured for BM-Case1 per BWP  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  [4. Maximum number of inference report(s) activated for BM-Case1 per BWP]  [4a. Maximum number of inference report(s) activated for BM-Case1 across all CCs]  [5. Maximum number of inference report(s) triggered for BM-Case1 per BWP]  [5a. Maximum number of inference report(s) triggered for BM-Case1 across all CCs]  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[~~7. Supported combinations of the number of resources for Set B and the number of resources for Set A~~]~~  ~~[~~7a: Supported maximum number of resources for Set B~~]~~  ~~[~~7b: Supported maximum number of resources for Set A~~]~~  [8. Supported CSI-RS resource types: Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS]  [9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report]  ~~[10. Supported options for performance monitoring for beam case 1 with UE side model]~~  ~~[11. Supported BM-Case 1 sub-usecase(s): {setB-subset-of-setA, setB-different-from-setA, both}]~~  12. Supported maximum number of predicted beams in each reporting instanceFFS: whether/how to merge this FG with other FG(s) for performance monitoring and/or data collection  13. The number of additional symbols, di, between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing predicted beam report, where  i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS  14. The number of additional symbols, di’, between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing predicted beam, where  i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS | FFS | yes | n/a | UE-side~~d~~ beam prediction for BM Case 1 [for inference] is not supported | FFS | FFS | FFS | FFS | Component 7 candidate values: {FFS: 1/2, 1/4, 1/8, …}  Component 7a candidate values: {FFS: 4, …, 32}  Component 7b candidate values: {FFS: 4, …, 64}  Component 12 candidate values: {FFS: 1, 2, 3, 4}  Component 13 candidate value sets: FFS  Component 14 candidate value sets: FFS  FFS: CPU/AIMLPU related information | Optional with capability signalling | |
| Apple [13] | **Proposal 2-1: Introduce components 4, 4a, 5 and 5a for SP AI/ML BM and AP AI/ML BM reporting under 58-1-2.**  **Proposal 2-2: Under 58-1-2, revise the wording of component 8 by removing “periodic” from “**Supported of periodic CSI-RS resource types for Set A” **.**  **Proposal 2-3: Keep “for inference” for feature group description for 58-1-2.** |
| CMCC [14] | It is fine to remain purpose “for inference” since UE feature for inference seems can not apply for other purposes like data collection or monitoring.  Based on RAN1#118b meeting agreement below, multiple CSI reports for inference for UE-side model can be configured/activated/triggered. The maximum number of configured/activated/triggered CSI reports across BM-Case 1 and BM-Case 2 should be reported in UE capability.   |  | | --- | | Agreement@118b  For beam management, multiple CSI reports for inference for UE-side model can be configured/activated/triggered, which is up to UE capability. |   Regarding to RS type for Set A, since following RAN1 agreement has agreed RS type of set A can be CSI-RS or SSB, similar as component 6 and 6a, the support of two RS type for Set A can be reported in UE capability.   |  | | --- | | Agreement@120  For UE-sided model, for configuring the resource for data collection purpose, support   * *CSI-ReportConfig* can used for configuring the resources for data collection purpose without CSI report.   + One *CSI-ResourceConfigId* is configured for Set A.   + One *CSI-ResourceConfigId* is configured for Set B.   + Note: UE performs measurement on all resources   + One or two associated IDs can be configured in *CSI-ReportConfig*     - When Set B is equal or a subset of set A (i.e., *NZP-CSI-RS-ResourceId*/*SSB-Index* in the resource setfor Set B is within the *NZP-CSI-RS-ResourceId*/*SSB-Index* in the resource setfor Set A), one associated ID is configured,     - Otherwise, one associated ID is configured for Set A and another one associated ID is configured for Set B * FFS: whether/how to support 'aperiodic' CSI RS   Note: This is not related to whether/how to support delivery/transmission of the collected data for training for UE-sided model. |   Components 7a+7b of FG 58-1-2 are preferred than component 7. In UE capability reporting, UE should report maximum capability. On the other hand, if we go with component 7, there will be too many combinations of set B size and set A size, the overhead is huge. With components 7a+7b, UE can check whether set B size or set A size in inference configuration or inference related parameters can match that of AI models during applicable function reporting procedure.  Components 8,9,11 of FG 58-1-2 are supported to assist gNB to provide proper inference configuration during applicable function reporting procedure.  Component 10 should at least include Type 1 Option 1 monitoring to guarantee gNB can control the inference performance of AI model.  In RAN#108 meeting, the proposal in RP-251823 (Revision of RP-251658) was endorsed for AI/ML PU sharing A UE can report support for N (up to 2) AI/ML PU pools for AI/ML features. For each of the N AI/ML PU pools, UE reports the maximum number of simultaneous AI/ML PUs, respectively. If N = 2, for each AI/ML feature, UE reports which AI/ML PU pool it belongs to. Thus, UE should report number of AI/ML PU pools for AI/ML features, which AI/ML PU pool AI-based beam prediction belongs to, and the maximum number of simultaneous AI/ML PUs for this pool in UE feature.  ***Proposal 1: Take the following modification (in red) for the feature of Rel-19 AI based beam management:***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-2 | UE-side beam prediction for BM Case1 ~~[~~for inference~~]~~ | 1. Support of beam prediction with reporting of predicted beam index for BM-Case1 ~~[~~for inference~~]~~ with UE-side model  ~~[2. Supported mapping pattern between set B and set A]~~  ~~[~~3. Maximum number of inference report(s) configured for BM-Case1 per BWP~~]~~  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  [4. Maximum number of inference report(s) activated for BM-Case1 per BWP]  ~~[~~4a. Maximum number of inference report(s) activated for BM-Case1 across all CCs~~]~~  [5. Maximum number of inference report(s) triggered for BM-Case1 per PWB]  ~~[~~5a. Maximum number of inference report(s) triggered for BM-Case1 across all CCs~~]~~  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  ~~FFS: RS type for Set A~~  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[7. Supported combinations of the number of resources for Set B and the number of resources for Set A]~~  ~~[~~7a: Supported maximum number of resources for Set B~~]~~  ~~[~~7b: Supported maximum number of resources for Set A~~]~~  ~~FFS: component 7 or component 7a+7b or 7+7a+7b~~  ~~[~~8. Supported of ~~periodic~~ CSI-RS resource types for Set A: Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS~~]~~  ~~[~~9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report~~]~~  ~~[~~10. Supported options for performance monitoring for beam case 1 with UE side model~~]~~  ~~[~~11. Supported BM-Case 1 sub-usecase(s): {setB-subset-of-setA, setB-different-from-setA, both}~~]~~  ~~[~~12. Supported maximum number of predicted beams in each reporting instance~~]~~  13. Supported number of AI/ML PU pools for AI/ML features  14. AI/ML PU pool for beam prediction  15. Maximum number of simultaneous AI/ML PUs for beam prediction pool | FFS | yes | n/a | UE-side~~d~~ beam prediction for BM Case 1 ~~[~~for inference~~]~~ is not supported | FFS | FFS | FFS | FFS | ~~FFS: Further partitioning of this FG based on existing and future agreements~~  FFS: CPU/AIMLPU related information  ~~FFS: candidate values for~~ Component 12 candidate values: {1, 2, 4} | Optional with capability signalling | |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-2 | UE-side beam prediction for BM Case1 [for inference] | 1. Support of beam prediction with reporting of predicted beam index for BM-Case1 [for inference] with UE-side model  3. Maximum number of inference report(s) configured for BM-Case1 per BWP  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  ~~[4. Maximum number of inference report(s) activated for BM-Case1 per BWP]~~  ~~[4a. Maximum number of inference report(s) activated for BM-Case1 across all CCs]~~  ~~[5. Maximum number of inference report(s) triggered for BM-Case1 per PWB]~~  ~~[5a. Maximum number of inference report(s) triggered for BM-Case1 across all CCs]~~  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[7. Supported combinations of the number of resources for Set B and the number of resources for Set A]~~  [7a: Supported maximum number of resources for Set B]  [7b: Supported maximum number of resources for Set A]  ~~FFS: component 7 or component 7a+7b or 7+7a+7b~~  [8. Supported ~~of periodic~~ CSI-RS resource types for Set A: Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS]  [9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report]  ~~[10. Supported options for performance monitoring for beam case 1 with UE side model]~~  [11. Supported BM-Case 1 sub-usecase(s): {setB-subset-of-setA, setB-different-from-setA, both}]  12. Supported maximum number of predicted beams in each reporting instance  13. Supported CSI-RS resource types for Set B: Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS  14. values  15. values  16. and values per subcarrier | FFS | yes | n/a | UE-side~~d~~ beam prediction for BM Case 1 [for inference] is not supported | FFS | FFS | FFS | FFS | ~~FFS: CPU/AIMLPU related information~~  Component 12 candidate values: {1, 2, 4}  Component 7a candidate values: {4, 8, 16}  Component 7b candidate values: {16, 32, 64}  Component 14 candidate values: INTEGER (1..8)  Component 15 candidate values: INTEGER (0..8)  Component 16 candidate values: for , the corresponding values for and are: {56,112,224,448,896,1792,3584}, respectively. | Optional with capability signalling | |
| NTT DOCOMO, INC. [16] | At the previous RAN1 meetings, it was agreed to introduce separate FGs for only beam indication and/or predicted RSRP for BM-case1. If the predicted RSRP is available, the top-K predicted beams can be obtained from the predicted RSRP. Hence, the FG for reporting only beam indication can be the prerequisite of the FG for reporting predicted RSRP.  According to the AI/ML model deployed at UE, the applicable combination of the number of Set A and the number of Set B is different. For example, some UE is capable of beam prediction “from 4 Set B beams to 16 beams” and “from 8 Set B beams to 64 beams”, while the prediction “from 4 Set B beams to 64 beams” cannot be performed. Taking it into consideration, the combination of the maximum number of Set A and the minimum number of Set B should be reported as component in these FG.   |  | | --- | | Agreement  For beam management, multiple CSI reports for inference for UE-side model can be configured/activated/triggered, which is up to UE capability. |   In the previous RAN1 meeting, it was agreed that the maximum number of configured/activated/triggered CSI reporting for UE side model is up to UE capability, as above. In the legacy CSI reporting, the number of processed activated CSI reporting is restricted by the maximum CSI processing units UE supports. This principle can be reused in AI/ML too. Also, the number of activated AI/ML-based CSI reporting can be covered by 58-0-1 regarding maximum number of APUs. Hence, there is no need for UE to report the maximum number of activated/triggered CSI reporting even for AI/ML-based CSI reporting.  Another issue is the APU occupation for the beam prediction, a new component should be introduced to reflect the following agreement from RAN1#121.   |  | | --- | | Agreement  For UE-side model, for AI/ML based beam management for BM-Case 1 and BM-Case 2, for processing of a CSI report for inference,   * For PU occupancy, for the number of AI/ML PU (OAPU) and/or legacy CPU (OCPU) are occupied,   + OAPU= 0 or X1/X2 is reported by UE in UE capability report for BM-Case 1 and BM-Case 2 respectively   + OCPU=0 or Y1/Y2 is reported by UE in UE capability report for BM-Case 1 and BM-Case 2 respectively   + Note: Detailed values of X1/X2 and Y1/Y2 can be further discussed in UE feature.   + Note: Combination of OAPU= 0 and OCPU=0 is not allowed   + Note: if any of the unoccupied PU cannot satisfy the corresponding required PU by the CSI report, the CSI report will follow the legacy behavior of exceeding the CPU limit, neither of the PUs are occupied |   It is noted in the agreements that detailed values of X1/X2 and Y1/Y2 can be further discussed in UE feature. For APU (i.e., CPU\_2 in current specification) occupations, if a UE can report arbitrary number, there will be no consensus on the understanding of the APU between NW and UE. The maximum APU resources reported by UE is meaningless then. The NW cannot manage the configurations for UEs to fully utilize the AI/ML capability of UEs in the network. To avoid this and meanwhile to reflect the different UE implementations with different model size, we suggest the restrictions on the candidate values of O\_APU. For example, N\_small and N\_large besides the value 0 for UE using small- or large-scale models. For CPU occupation, the number of candidate values should also be restricted. Besides O\_CPU=0, O\_CPU can be 1 when both CPU and APU are occupied and the AI/ML models run on the APU; and O\_CPU can be a large number, e.g., 8, for CPU based prediction.  Also, this feature is not related to CA, so the type should be per UE (or per band).  **Proposal 4: Update FG 58-1-2 and 58-1-3 as follows.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-2 | UE-side beam prediction for BM Case1 ~~[~~for inference~~]~~ | 1. Support of beam prediction with reporting of predicted beam index for BM-Case1 ~~[~~for inference~~]~~ with UE-side model  3. Maximum number of inference report(s) configured for BM-Case1 per BWP  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  ~~[4. Maximum number of inference report(s) activated for BM-Case1 per BWP]~~  ~~[4a. Maximum number of inference report(s) activated for BM-Case1 across all CCs]~~  ~~[5. Maximum number of inference report(s) triggered for BM-Case1 per PWB]~~  ~~[5a. Maximum number of inference report(s) triggered for BM-Case1 across all CCs]~~  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[7. Supported combinations of the number of resources for Set B and the number of resources for Set A]~~  ~~[7a: Supported maximum number of resources for Set B]~~  ~~[7b: Supported maximum number of resources for Set A]~~  ~~[~~8. Supported of CSI-RS resource types for Set A: Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS~~]~~  ~~[9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report]~~  ~~[10. Supported options for performance monitoring for beam case 1 with UE side model]~~  ~~[~~11. Supported BM-Case 1 sub-usecase(s): {setB-subset-of-setA, setB-different-from-setA, both}~~]~~  12. Supported maximum number of predicted beams in each reporting instance  13. A list of supported combinations, each combination is {minimum required number of SSB/CSI-RS resources to be measured, maximum number of SSB/CSI-RS resources to be predicted}  14. Index about which APU resource pool is CPU\_2.  15. Value of CPU\_1 occupation.  16. Value of CPU\_2 occupation. | 2-24, 58-0-1 | yes | n/a | UE-side~~d~~ beam prediction for BM Case 1 ~~[~~for inference~~]~~is not supported | Per UE | No | No |  | Component 12 Candidate value set: {1, 2, 3, 4}  Candidate value of the minimum required number of SSB/CSI-RS resources to be measured in Component 13: {4, 8, 16, 32}  Candidate value of the maximum number of SSB/CSI-RS resources to be predicted in Component 13: {16, 32, 64, 128}  Candidate values for component 14: {1,2}  Candidate values for component 15: {0, 1, 8}  Candidate values for component 16: {0, 2, 4} | Optional with capability signalling | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. NR\_AIML\_air | 58-1-3 | UE-side beam prediction for BM Case1 with predicted RSRP [for inference] | 1. Support of beam prediction, reporting of predicted beam index and predicted RSRP, for BM-Case1 [for inference]  2. Supported maximum number of predicted beams with RSRP in each reporting instance | 58-1-2 | yes | n/a | UE-side beam prediction for BM Case 1 with predicted RSRP [for inference] is not supported | FFS | FFS | FFS | FFS | FFS: CPU/AIMLPU related information | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Ericsson [2] | The values of X1/X2/Y1/Y2 need to be addressed to complete the feature. To reduce the complexity for the NW to handle many different combinations of PU occupancies, a limited number of values should be supported. Two unique values for X1/X2/Y1/Y2 are proposed as a starting point, the exact value is based on the estimated complexity for BM-Case 1 and BM-Case2. Given the increased model input/output of BM-Case 2, it likely should have larger complexity.  Furthermore, the following proposed way forward was endorsed in RANP #108.   |  | | --- | | Proposal   * A UE can report support for N (up to 2) AI/ML PU pools for AI/ML features   - For each of the N AI/ML PU pools, UE reports the maximum number of simultaneous AI/ML PUs, respectively.  - If N = 2, for each AI/ML use case feature, UE reports which AI/ML PU pool it belongs to. |   This means that when the UE supports N=2 APU pools, then the APU pool index associated with AI/ML UE feature needs to be included as part of the capability report.   1. For the values of X1/X2 and Y1/Y2, support a limited number of values. Assume X1/X2/Y1/Y2 can take 2 unique values as a starting point. 2. As part of FGs 58-1-2, 58-1-3, 58-1-4, and 58-1-5, introduce APU pool index associated with the FG when 2 APU pools are supported by the UE.   Regarding the values of d and d’, if a large value is supported, the NW might receive outdated predictions at least for BM-Case 1. Moreover, it could occupy the PU resources an extensive amount of time, limiting the NW flexibility to configure other CSI-reports. Our view is that the extension should not support large values of d and d’.   1. For the values of d and d’, do not support large values since it would reduce the usefulness of the predictions, in particular for BM-Case 1, and would limit the NW flexibility to configure other CSI reports.   For the UE-side beam prediction for BM-Case 1 and BM-Case 2, the agreed UE feature definition is almost complete. Only a clarification is needed that the UE should also support the performance monitoring as part of the feature.   1. For components of FG 58-1-2, FG 58-1-3, FG 58-1-4 and FG 58-1-5 in addition to the agreed components, add the component: “Support UE-assisted performance monitoring.” |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-3 | UE-side beam prediction for BM Case1 with predicted RSRP | 1. Support of beam prediction, reporting of predicted beam index and predicted RSRP, for BM-Case1  2. Supported maximum number of predicted beams with RSRP in each reporting instance | 58-1-2 | yes | n/a | UE-side beam prediction for BM Case 1 with predicted RSRP is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling | |
| CATT/CICTCI [4] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-3 | UE-side beam prediction for BM Case1 with predicted RSRP ~~[~~for inference~~]~~ | 1. Support of beam prediction, reporting of predicted beam index and predicted RSRP, for BM-Case1 ~~[~~for inference~~]~~  2. Supported maximum number of predicted beams with RSRP in each reporting instance | 58-1-2 | yes | n/a | UE-side beam prediction for BM Case 1 with predicted RSRP~~[~~for inference~~]~~ is not supported | FFS | FFS | FFS | FFS | FFS: CPU/AIMLPU related information | Optional with capability signalling | |
| Huawei/HiSilicon [5] | **Notation of 58-1-2/58-1-3**  Regarding the notation of the two FGs, there is square bracket on [for inference]. We think [for inference] can be removed, since there is no previous BM UE feature for beam prediction.  In the following, we provide our views to the components.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-3 | UE-side beam prediction for BM Case1 with predicted RSRP ~~[for inference]~~ | 1. Support of beam prediction, reporting of predicted beam index and predicted RSRP, for BM-Case1 ~~[for inference]~~  2. Supported maximum number of predicted beams with RSRP in each reporting instance | 58-1-2 | yes | n/a | UE-side beam prediction for BM Case 1 with predicted RSRP ~~[for inference]~~ is not supported | FFS: CPU/AIMLPU related information | Optional with capability signalling | |
| Vivo [6] | For FG 58-1-2, it is acceptable to retain the purpose as "for inference", since the UE inference feature is designated exclusively for this function and cannot be repurposed for other purposes such as data collection or monitoring.   1. For components of FG 58-1-2, FG 58-1-3, FG 58-1-4 and FG 58-1-5, support to retain the purpose as "for inference".  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-3 | UE-side beam prediction for BM Case1 with predicted RSRP ~~[for inference]~~ for inference | 1. Support of beam prediction, reporting of predicted beam index and predicted RSRP, for BM-Case1 ~~[for inference]~~ for inference  2. Supported maximum number of predicted beams with RSRP in each reporting instance | 58-1-2 | yes | UE-side beam prediction for BM Case 1 with predicted RSRP ~~[for inference]~~ for inference is not supported | FFS: CPU/AIMLPU related information | |
| Xiaomi [7] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-3 | UE-side beam prediction for BM Case1 with predicted RSRP for inference | 1. Support of beam prediction, reporting of predicted beam index and predicted RSRP, for BM-Case1 for inference  2. Supported maximum number of predicted beams with RSRP in each reporting instance  3. Number of occupied CPU  4. Number of occupied APU  4a. APU pool index.  FFS: other components | 58-1-2 | yes | n/a | UE-side beam prediction for BM Case 1 with predicted RSRP for inference is not supported | FFS | FFS | FFS | FFS | FFS: candidate values for Component 2 candidate values: {1, 2, 4}  FFS: CPU/AIMLPU related information | Optional with capability signalling | |
| ZTE Corporation/Sanechips [8] | Regarding the components of FG58-1-2~FG58-1-5, the “FFS: CPU/AIMLPU related information” can be addressed by allowing the UE to report the occupied CPU and/or AIMLPU.  ***Proposal 4****:* *Regarding the components of FG58-1-2~FG58-1-5, UE reports the occupied CPU and/or AIMLPU.* |
| Samsung [9] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-3 | UE-side beam prediction for BM Case1 with predicted RSRP ~~[for inference]~~ | 1. Support of beam prediction, reporting of predicted beam index and predicted RSRP, for BM-Case1 ~~[for inference]~~  2. Supported maximum number of predicted beams with RSRP in each reporting instance | 58-1-2 | yes | n/a | UE-side beam prediction for BM Case 1 with predicted RSRP ~~[for inference]~~ is not supported | FFS | FFS | FFS | FFS | candidate values: {1, 2, 4}  ~~FFS: CPU/AIMLPU related information~~ | Optional with capability signalling | |
| Ofinno [10] |  |
| OPPO [11] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-3 | UE-side beam prediction for BM Case1 with predicted RSRP for inference | 1. Support of beam prediction, reporting of predicted beam index and predicted RSRP, for BM-Case1 for inference  2. Supported maximum number of predicted beams with RSRP in each reporting instance  FFS: other components | 58-1-2 | yes | n/a | UE-side beam prediction for BM Case 1 with predicted RSRP for inference is not supported | FFS | FFS | FFS | FFS | ~~FFS: candidate values for Component 2 candidate values: {1, 2, 4}~~  ~~FFS: CPU/AIMLPU related information~~ | Optional with capability signalling | |
| LG Electronics [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-3 | UE-side beam prediction for BM Case1 with predicted RSRP [for inference] | 1. Support of beam prediction, reporting of predicted beam index and predicted RSRP, for BM-Case1 [for inference]  2. Supported maximum number of predicted beams with RSRP in each reporting instance  3. The number of additional symbols, di, between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing predicted beam report, where  i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS  4. The number of additional symbols, di’, between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing predicted beam, where  i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS | 58-1-2 | yes | n/a | UE-side beam prediction for BM Case 1 with predicted RSRP [for inference] is not supported | FFS | FFS | FFS | FFS | Component 2 candidate values: {FFS: 1, 2, 3, 4}  Component 3 candidate value sets: FFS  Component 4 candidate value sets: FFS  FFS: CPU/AIMLPU related information | Optional with capability signalling | |
| Apple [13] | **Proposal 2-3a: Keep “for inference” for feature group description for 58-1-3.** |
| CMCC [14] | It is fine to remain purpose “for inference” since UE feature for inference seems can not apply for other purposes like data collection or monitoring.  Based on RAN1#118b meeting agreement below, multiple CSI reports for inference for UE-side model can be configured/activated/triggered. The maximum number of configured/activated/triggered CSI reports across BM-Case 1 and BM-Case 2 should be reported in UE capability.   |  | | --- | | Agreement@118b  For beam management, multiple CSI reports for inference for UE-side model can be configured/activated/triggered, which is up to UE capability. |   Regarding to RS type for Set A, since following RAN1 agreement has agreed RS type of set A can be CSI-RS or SSB, similar as component 6 and 6a, the support of two RS type for Set A can be reported in UE capability.   |  | | --- | | Agreement@120  For UE-sided model, for configuring the resource for data collection purpose, support   * *CSI-ReportConfig* can used for configuring the resources for data collection purpose without CSI report.   + One *CSI-ResourceConfigId* is configured for Set A.   + One *CSI-ResourceConfigId* is configured for Set B.   + Note: UE performs measurement on all resources   + One or two associated IDs can be configured in *CSI-ReportConfig*     - When Set B is equal or a subset of set A (i.e., *NZP-CSI-RS-ResourceId*/*SSB-Index* in the resource setfor Set B is within the *NZP-CSI-RS-ResourceId*/*SSB-Index* in the resource setfor Set A), one associated ID is configured,     - Otherwise, one associated ID is configured for Set A and another one associated ID is configured for Set B * FFS: whether/how to support 'aperiodic' CSI RS   Note: This is not related to whether/how to support delivery/transmission of the collected data for training for UE-sided model. |   Components 7a+7b of FG 58-1-2 are preferred than component 7. In UE capability reporting, UE should report maximum capability. On the other hand, if we go with component 7, there will be too many combinations of set B size and set A size, the overhead is huge. With components 7a+7b, UE can check whether set B size or set A size in inference configuration or inference related parameters can match that of AI models during applicable function reporting procedure.  Components 8,9,11 of FG 58-1-2 are supported to assist gNB to provide proper inference configuration during applicable function reporting procedure.  Component 10 should at least include Type 1 Option 1 monitoring to guarantee gNB can control the inference performance of AI model.  In RAN#108 meeting, the proposal in RP-251823 (Revision of RP-251658) was endorsed for AI/ML PU sharing A UE can report support for N (up to 2) AI/ML PU pools for AI/ML features. For each of the N AI/ML PU pools, UE reports the maximum number of simultaneous AI/ML PUs, respectively. If N = 2, for each AI/ML feature, UE reports which AI/ML PU pool it belongs to. Thus, UE should report number of AI/ML PU pools for AI/ML features, which AI/ML PU pool AI-based beam prediction belongs to, and the maximum number of simultaneous AI/ML PUs for this pool in UE feature.  ***Proposal 1: Take the following modification (in red) for the feature of Rel-19 AI based beam management:***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-3 | UE-side beam prediction for BM Case1 with predicted RSRP ~~[~~for inference~~]~~ | 1. Support of beam prediction, reporting of predicted beam index and predicted RSRP, for BM-Case1 ~~[~~for inference~~]~~  ~~[~~2. Supported maximum number of predicted beams with RSRP in each reporting instance~~]~~ | 58-1-2 | yes | n/a | UE-side beam prediction for BM Case 1 with predicted RSRP [for inference] is not supported | FFS | FFS | FFS | FFS | ~~FFS: candidate values for~~ Component 2 candidate values: {1, 2, 4}  FFS: CPU/AIMLPU related information | Optional with capability signalling | |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-3 | UE-side beam prediction for BM Case1 with predicted RSRP [for inference] | 1. Support of beam prediction, reporting of predicted beam index and predicted RSRP, for BM-Case1 [for inference]  2. Supported maximum number of predicted beams with RSRP in each reporting instance | 58-1-2 | yes | n/a | UE-side beam prediction for BM Case 1 with predicted RSRP [for inference] is not supported | FFS | FFS | FFS | FFS | ~~Component 2 candidate values: {1, 2, 4}~~  ~~FFS: CPU/AIMLPU related information~~ | Optional with capability signalling | |
| NTT DOCOMO, INC. [16] | At the previous RAN1 meetings, it was agreed to introduce separate FGs for only beam indication and/or predicted RSRP for BM-case1. If the predicted RSRP is available, the top-K predicted beams can be obtained from the predicted RSRP. Hence, the FG for reporting only beam indication can be the prerequisite of the FG for reporting predicted RSRP.  According to the AI/ML model deployed at UE, the applicable combination of the number of Set A and the number of Set B is different. For example, some UE is capable of beam prediction “from 4 Set B beams to 16 beams” and “from 8 Set B beams to 64 beams”, while the prediction “from 4 Set B beams to 64 beams” cannot be performed. Taking it into consideration, the combination of the maximum number of Set A and the minimum number of Set B should be reported as component in these FG.   |  | | --- | | Agreement  For beam management, multiple CSI reports for inference for UE-side model can be configured/activated/triggered, which is up to UE capability. |   In the previous RAN1 meeting, it was agreed that the maximum number of configured/activated/triggered CSI reporting for UE side model is up to UE capability, as above. In the legacy CSI reporting, the number of processed activated CSI reporting is restricted by the maximum CSI processing units UE supports. This principle can be reused in AI/ML too. Also, the number of activated AI/ML-based CSI reporting can be covered by 58-0-1 regarding maximum number of APUs. Hence, there is no need for UE to report the maximum number of activated/triggered CSI reporting even for AI/ML-based CSI reporting.  Another issue is the APU occupation for the beam prediction, a new component should be introduced to reflect the following agreement from RAN1#121.   |  | | --- | | Agreement  For UE-side model, for AI/ML based beam management for BM-Case 1 and BM-Case 2, for processing of a CSI report for inference,   * For PU occupancy, for the number of AI/ML PU (OAPU) and/or legacy CPU (OCPU) are occupied,   + OAPU= 0 or X1/X2 is reported by UE in UE capability report for BM-Case 1 and BM-Case 2 respectively   + OCPU=0 or Y1/Y2 is reported by UE in UE capability report for BM-Case 1 and BM-Case 2 respectively   + Note: Detailed values of X1/X2 and Y1/Y2 can be further discussed in UE feature.   + Note: Combination of OAPU= 0 and OCPU=0 is not allowed   + Note: if any of the unoccupied PU cannot satisfy the corresponding required PU by the CSI report, the CSI report will follow the legacy behavior of exceeding the CPU limit, neither of the PUs are occupied |   It is noted in the agreements that detailed values of X1/X2 and Y1/Y2 can be further discussed in UE feature. For APU (i.e., CPU\_2 in current specification) occupations, if a UE can report arbitrary number, there will be no consensus on the understanding of the APU between NW and UE. The maximum APU resources reported by UE is meaningless then. The NW cannot manage the configurations for UEs to fully utilize the AI/ML capability of UEs in the network. To avoid this and meanwhile to reflect the different UE implementations with different model size, we suggest the restrictions on the candidate values of O\_APU. For example, N\_small and N\_large besides the value 0 for UE using small- or large-scale models. For CPU occupation, the number of candidate values should also be restricted. Besides O\_CPU=0, O\_CPU can be 1 when both CPU and APU are occupied and the AI/ML models run on the APU; and O\_CPU can be a large number, e.g., 8, for CPU based prediction.  Also, this feature is not related to CA, so the type should be per UE (or per band).  **Proposal 4: Update FG 58-1-2 and 58-1-3 as follows.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-3 | UE-side beam prediction for BM Case1 with predicted RSRP ~~[~~for inference~~]~~ | 1. Support of beam prediction, reporting of predicted beam index and predicted RSRP, for BM-Case1 ~~[~~for inference~~]~~  2. Supported maximum number of predicted beams with predicted RSRP in each reporting instance | 58-1-2 | yes | n/a | UE-side beam prediction for BM Case 1 with predicted RSRP ~~[~~for inference~~]~~is not supported | Per UE | No | No |  | Candidate values for Component 2 candidate values: {1, 2, 3, 4}  ~~FFS: CPU/AIMLPU related information~~ | Optional with capability signalling | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 [for inference] | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 [for inference] with UE-side model  3. Maximum number of inference report(s) configured for BM-Case2 per BWP  3a. Maximum number of inference report(s) configured for BM-Case2 across all CCs  [4. Maximum number of inference report(s) activated for BM-Case2 per BWP]  [4a. Maximum number of inference report(s) activated for BM-Case2 across all CCs]  [5. Maximum number of inference report(s) triggered for BM-Case2 per BWP]  [5a. Maximum number of inference report(s) triggered for BM-Case2 across all CCs]  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  [7. Supported combinations of the number of resources for Set B and the number of resources for Set A]  [7a: Supported maximum number of resources for Set B]  [7b: Supported maximum number of resources for Set A][8. Supported CSI-RS resource types: Periodic CSI-RS, Semi-persistent CSI-RS]  [9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report]  [10. Supported options for performance monitoring for beam case 2 with UE side model]  11. Supported maximum number of predicted beams in each predicted time instance  12. Supported maximum number of predicted time instances  [13. Supported maximum total number of reported predicted beams for predicted time instances in one report]  [20. Supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, or merged version(s)] | FFS | yes | n/a | UE-side beam prediction for BM-Case2 [for inference] is not supported | FFS | FFS | FFS | FFS | FFS: CPU/AIMLPU related information  FFS: candidate values for components | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Ericsson [2] | The values of X1/X2/Y1/Y2 need to be addressed to complete the feature. To reduce the complexity for the NW to handle many different combinations of PU occupancies, a limited number of values should be supported. Two unique values for X1/X2/Y1/Y2 are proposed as a starting point, the exact value is based on the estimated complexity for BM-Case 1 and BM-Case2. Given the increased model input/output of BM-Case 2, it likely should have larger complexity.  Furthermore, the following proposed way forward was endorsed in RANP #108.   |  | | --- | | Proposal   * A UE can report support for N (up to 2) AI/ML PU pools for AI/ML features   - For each of the N AI/ML PU pools, UE reports the maximum number of simultaneous AI/ML PUs, respectively.  - If N = 2, for each AI/ML use case feature, UE reports which AI/ML PU pool it belongs to. |   This means that when the UE supports N=2 APU pools, then the APU pool index associated with AI/ML UE feature needs to be included as part of the capability report.   1. For the values of X1/X2 and Y1/Y2, support a limited number of values. Assume X1/X2/Y1/Y2 can take 2 unique values as a starting point. 2. As part of FGs 58-1-2, 58-1-3, 58-1-4, and 58-1-5, introduce APU pool index associated with the FG when 2 APU pools are supported by the UE.   Regarding the values of d and d’, if a large value is supported, the NW might receive outdated predictions at least for BM-Case 1. Moreover, it could occupy the PU resources an extensive amount of time, limiting the NW flexibility to configure other CSI-reports. Our view is that the extension should not support large values of d and d’.   1. For the values of d and d’, do not support large values since it would reduce the usefulness of the predictions, in particular for BM-Case 1, and would limit the NW flexibility to configure other CSI reports.   For the UE-side beam prediction for BM-Case 1 and BM-Case 2, the agreed UE feature definition is almost complete. Only a clarification is needed that the UE should also support the performance monitoring as part of the feature.   1. For components of FG 58-1-2, FG 58-1-3, FG 58-1-4 and FG 58-1-5 in addition to the agreed components, add the component: “Support UE-assisted performance monitoring.” |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 with UE-side model  3. Maximum number of inference report(s) configured for BM-Case2 per BWP  3a. Maximum number of inference report(s) configured for BM-Case2 across all CCs  [4. Maximum number of inference report(s) activated for BM-Case2 per BWP]  [4a. Maximum number of inference report(s) activated for BM-Case2 across all CCs]  [5. Maximum number of inference report(s) triggered for BM-Case2 per BWP]  [5a. Maximum number of inference report(s) triggered for BM-Case2 across all CCs]  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  7a: Supported maximum number of resources for Set B  7b: Supported maximum number of resources for Set A  8. Supported CSI-RS resource types: Periodic CSI-RS, Semi-persistent CSI-RS  9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report  10. Support performance monitoring for beam case 2  11. Supported maximum number of predicted beams in each predicted time instance  12. Supported maximum number of predicted time instances  20. Supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, or merged version(s)  [x. Indicate the additional CPU pool used for this feature  x. Values for CPU occupation in CPU and additional CPU pools] | FFS | yes | n/a | UE-side beam prediction for BM-Case2 is not supported | FFS | FFS | FFS | FFS | FFS: CPU/AIMLPU related information  FFS: candidate values for components  [component x: Legacy pool = 0 or 1 CPU  Additional pool(s) = 0 or 1 CPU.,  0 & 0 is not valid combination ] | Optional with capability signalling | |
| CATT/CICTCI [4] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 ~~[~~for inference~~]~~ | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 ~~[~~for inference~~]~~ with UE-side model  ~~3. Maximum number of inference report(s) configured for BM-Case2 per BWP~~  ~~3a. Maximum number of inference report(s) configured for BM-Case2 across all CCs~~  ~~[4. Maximum number of inference report(s) activated for BM-Case2 per BWP]~~  ~~[4a. Maximum number of inference report(s) activated for BM-Case2 across all CCs]~~  ~~[5. Maximum number of inference report(s) triggered for BM-Case2 per BWP]~~  ~~[5a. Maximum number of inference report(s) triggered for BM-Case2 across all CCs]~~  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[~~7. Supported combinations of the number of resources for Set B and the number of resources for Set A~~]~~  [7a: Supported maximum number of resources for Set B]  [7b: Supported maximum number of resources for Set A][8. Supported CSI-RS resource types: Periodic CSI-RS, Semi-persistent CSI-RS]  ~~[9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report]~~  ~~[~~10. Supported options for performance monitoring for beam case 2 with UE side model~~]~~  11. Supported maximum number of predicted beams in each predicted time instance  12. Supported maximum number of predicted time instances  ~~[~~13. Supported maximum total number of reported predicted beams for predicted time instances in one report~~]~~  ~~[~~20. Supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, or merged version(s) ~~]~~ | FFS | yes | n/a | UE-side beam prediction for BM-Case2 [for inference] is not supported | FFS | FFS | FFS | FFS | FFS: CPU/AIMLPU related information  FFS: candidate values for components | Optional with capability signalling | |
| Huawei/HiSilicon [5] | **Notation of 58-1-4/58-1-5**  Similar to our analysis to 58-1-2/3, the “for inference” can be removed.  In the following, we provide our views to the components.  **58-1-4 components**   * Component 4/4a/5/5a/7/7a/7b/8/9/10: They are same to BM-Case 1, so same handling to 58-1-2 can be applied. * Component 13: Whether the total number of predicted beams will impact the UE capability can be further clarified. Straightforwardly, it can be represented by the combination of Component 11 and 12. * Component 20: Not sure whether setB-different-from-setA only refers to wide-to-narrow, or it can also be narrow-to-narrow. Can be further discussed. * Component 21 (new): Same as analyzed for BM-Case 1, a new component is added.  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 ~~[for inference]~~ | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 ~~[for inference]~~ with UE-side model  3. Maximum number of inference report(s) configured for BM-Case2 per BWP  3a. Maximum number of inference report(s) configured for BM-Case2 across all CCs  ~~[4. Maximum number of inference report(s) activated for BM-Case2 per BWP]~~  ~~[4a. Maximum number of inference report(s) activated for BM-Case2 across all CCs]~~  ~~[5. Maximum number of inference report(s) triggered for BM-Case2 per BWP]~~  ~~[5a. Maximum number of inference report(s) triggered for BM-Case2 across all CCs]~~  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[~~7. Supported combinations of the number of resources for Set B and the number of resources for Set A~~]~~  ~~[7a: Supported maximum number of resources for Set B]~~  ~~[7b: Supported maximum number of resources for Set A]~~  ~~[~~8. Supported CSI-RS resource types: Periodic CSI-RS, Semi-persistent CSI-RS~~]~~  ~~[~~9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report~~]~~  [10. Supported options for performance monitoring for beam case 2 with UE side model]  11. Supported maximum number of predicted beams in each predicted time instance  12. Supported maximum number of predicted time instances  ~~[13. Supported maximum total number of reported predicted beams for predicted time instances in one report]~~  [20. Supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, or merged version(s)]  21. The number of symbols di introduced for the timeline of inference in addition to legacy Z3/Z3’, where i is the index of SCS, i=1,2,3,4,5,6 corresponding to 15,30,60,120,480,960 kHz SCS. | FFS | yes | n/a | UE-side beam prediction for BM-Case2 ~~[for inference]~~ is not supported | FFS: CPU/AIMLPU related information  FFS: candidate values for components  FFS: Component 21 candidate values | Optional with capability signalling | |
| Vivo [6] | For FG 58-1-2, it is acceptable to retain the purpose as "for inference", since the UE inference feature is designated exclusively for this function and cannot be repurposed for other purposes such as data collection or monitoring.   1. For components of FG 58-1-2, FG 58-1-3, FG 58-1-4 and FG 58-1-5, support to retain the purpose as "for inference".   Components 7a and 7b of FG 58-1-2 and FG 58-1-4 offer a superior alternative to component 7. Within the UE capability reporting framework, it is mandatory that the UE declares its maximum capability. Critically, the adoption of component 7 would exponentially increase the combinatorial complexity of Set B and Set A dimensions, resulting in prohibitive signaling overhead. By leveraging components 7a and 7b, the UE can actively validate during the applicable report procedure whether the Set B size or Set A size within inference configuration parameters conforms to the deployed AI models. Concurrently, the minimum capability threshold of Set B must be reported to the network to prevent invalid configuration attempts and optimize resource allocation.   1. For components of FG 58-1-2 and FG 58-1-4 in addition to the agreed components:  * **Support 7a: supported maximum number of resources for Set B + 7b: supported maximum number of resources for Set A** * **Support 7c: supported minimum number of resources for Set B**  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 ~~[for inference]~~ for inference | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 ~~[for inference]~~ for inference with UE-side model  3. Maximum number of inference report(s) configured for BM-Case2 per BWP  3a. Maximum number of inference report(s) configured for BM-Case2 across all CCs  [4. Maximum number of inference report(s) activated for BM-Case2 per BWP]  [4a. Maximum number of inference report(s) activated for BM-Case2 across all CCs]  [5. Maximum number of inference report(s) triggered for BM-Case2 per BWP]  [5a. Maximum number of inference report(s) triggered for BM-Case2 across all CCs]  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[7. Supported combinations of the number of resources for Set B and the number of resources for Set A]~~  7a: Supported maximum number of resources for Set B  7b: Supported maximum number of resources for Set A  7c: Supported minimum number of resources for Set B  [8. Supported CSI-RS resource types: Periodic CSI-RS, Semi-persistent CSI-RS]  [9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report]  [10. Supported options for performance monitoring for beam case 2 with UE side model]  11. Supported maximum number of predicted beams in each predicted time instance  12. Supported maximum number of predicted time instances  [13. Supported maximum total number of reported predicted beams for predicted time instances in one report]  [20. Supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, or merged version(s)] | FFS | yes | UE-side beam prediction for BM-Case2 ~~[for inference]~~ for inference is not supported | FFS: CPU/AIMLPU related information  FFS: candidate values for components | |
| Xiaomi [7] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 for inference | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 for inference with UE-side model  3. Maximum number of inference report(s) configured for BM-Case2 per BWP  3a. Maximum number of inference report(s) configured for BM-Case2 across all CCs  4. Maximum number of inference report(s) activated for BM-Case2 per BWP  4a. Maximum number of inference report(s) activated for BM-Case2 across all CCs  5. Maximum number of inference report(s) triggered for BM-Case2 per BWP  5a. Maximum number of inference report(s) triggered for BM-Case2 across all CCs  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  7. Supported combinations of the number of resources for Set B and the number of resources for Set A  8. Supported CSI-RS resource types for Set A/B: Periodic CSI-RS, Semi-persistent CSI-RS  9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report  11. Supported maximum number of predicted beams in each predicted time instance  12. Supported maximum number of predicted time instances  13. Supported maximum total number of reported predicted beams for predicted time instances in one report  20. Supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, or merged version(s)  21. Supported combinations of time gaps between predicted time instances and value of set B periodicity.  22. Number of occupied CPU  23. Number of occupied APU  23a. APU pool index.  FFS: whether/how to report the supported maximum total number of CSI reports across different AI/ML based use-cases  FFS: whether some of components will be reported dynamically instead of as capability  FFS: whether/how to merge this FG with other FG(s) for performance monitoring and/or data collection  FFS: whether/how to report each of supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, or merged version(s)  FFS: whether/how to merge some of above components to report combination(s) of supported values | FFS | yes | n/a | UE-side beam prediction for BM-Case2 for inference is not supported | FFS | FFS | FFS | FFS | FFS: Further partitioning of this FG based on existing and future agreements  FFS: CPU/AIMLPU related information  FFS: candidate values for components | Optional with capability signalling | |
| ZTE Corporation/Sanechips [8] | Regarding the components of FG58-1-2~FG58-1-5, the “FFS: CPU/AIMLPU related information” can be addressed by allowing the UE to report the occupied CPU and/or AIMLPU.  ***Proposal 4****:* *Regarding the components of FG58-1-2~FG58-1-5, UE reports the occupied CPU and/or AIMLPU.* |
| Samsung [9] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 ~~[for inference]~~ | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 ~~[for inference]~~ with UE-side model  3. Maximum number of inference report(s) configured for BM-Case2 per BWP  3a. Maximum number of inference report(s) configured for BM-Case2 across all CCs  ~~[~~4. Maximum number of inference report(s) activated for BM-Case2 per BWP~~]~~  [4a. Maximum number of inference report(s) activated for BM-Case2 across all CCs]  ~~[~~5. Maximum number of inference report(s) triggered for BM-Case2 per BWP~~]~~  [5a. Maximum number of inference report(s) triggered for BM-Case2 across all CCs]  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  [7. Supported combinations of the number of resources for Set B and the number of resources for Set A]  [7a: Supported maximum number of resources for Set B]  [7b: Supported maximum number of resources for Set A]  [8. Supported CSI-RS resource types for Set [A/B]: Periodic CSI-RS, Semi-persistent CSI-RS]  [9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report]  [10. Supported options for performance monitoring for beam case 2 with UE side model]  ~~[~~11. Supported maximum number of predicted beams in each predicted time instance~~]~~  ~~[~~12. Supported maximum number of predicted time instances~~]~~  [13. Supported maximum total number of reported predicted beams for predicted time instances in one report]  [20. Supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, or merged version(s)]  21. supported number of occupied CPU if *nroftimeinstance-r19* is configured  22. supported number of occupied APU if *nroftimeinstance-r19* is configured  23. supported value of d for the relaxation of Z3 timeline if *nroftimeinstance-r19* is configured  24. supported value of d’ for the relaxation of Z’3 timeline if *nroftimeinstance-r19* is configured | FFS | yes | n/a | UE-side beam prediction for BM-Case2 ~~[for inference]~~ is not supported | FFS | FFS | FFS | FFS | ~~FFS: CPU/AIMLPU related information~~  FFS: candidate values for components  Component 21 candidate values: FFS  Component 22 candidate values: FFS  Component 23 candidate values: FFS  Component 24 candidate values: FFS | Optional with capability signalling | |
| Ofinno [10] | * **Proposal:**   + **Add the following component in 58-1-4 as:**     - **14: Supported combinations of value(s) of valid time duration for each predicted time instance and the number of future time instance(s)**   + Related agreements:   **Agreement @120**  For inference, for BM-Case 2 of UE-side model,   * The time gap between two consecutive future time instances is configured by RRC, and the number of future time instance(s) *N* is configured by RRC.   + time gap is [10ms, 20ms, 40ms, 80ms, 160ms]   + N = [1, 2, 4, 8] * Reference time of the earliest time instance for the predicted results is based on the most recent occasion of the CSI-RS/SSB resource in Set B for measurement   + Where the most recent occasion of the CSI-RS/SSB resource of set B is the latest CSI-RS/SSB occasion no later than the corresponding CSI reference resource of the corresponding inference report.   **Agreement @120bis**  For BM-Case 2 of UE-side model, one RRC parameter represents the time gap configured for between two consecutive future time instances and also represents the time gap between the reference time and the first future time instance for prediction.   * + Reason     - Regarding inference, a UE may use a different model for inferencing based on different time gap and/or different number of future time instance(s). Based on the related agreements as shown in the above, the configured value of the time gap and the number of future time instances can be commonly used for all the inference models. Then, such UE may run the same number of inferences for the same number of future time instances regardless of the property of each inference model. To handle this issue, combinations between the time gap and the number of future time instance(s) can be considered. For example, the UE can support the following combinations where whole inference time (i.e. time gap value N) covers 80ms, i.e. {(10ms, 8), (20ms, 4), (40ms, 2), (80ms, 1)}  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 [for inference] | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 [for inference] with UE-side model  3. Maximum number of inference report(s) configured for BM-Case2 per BWP  3a. Maximum number of inference report(s) configured for BM-Case2 across all CCs  4. Maximum number of inference report(s) activated for BM-Case2 per BWP  [4a. Maximum number of inference report(s) activated for BM-Case2 across all CCs]  5. Maximum number of inference report(s) triggered for BM-Case2 per BWP  [5a. Maximum number of inference report(s) triggered for BM-Case2 across all CCs]  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  [7. Supported combinations of the number of resources for Set B and the number of resources for Set A]  [7a: Supported maximum number of resources for Set B]  [7b: Supported maximum number of resources for Set A]  [8. Supported CSI-RS resource types for Set [A/B]: Periodic CSI-RS, Semi-persistent CSI-RS]  [9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report]  [10. Supported options for performance monitoring for beam case 2 with UE side model]  11. Supported maximum number of predicted beams in each predicted time instance  12. Supported maximum number of predicted time instances  [13. Supported maximum total number of reported predicted beams for predicted time instances in one report]  14. Supported combinations of supported value(s) of valid time duration for each predicted time instance and number of predicted beams for each value of valid time duration  [20. Supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, or merged version(s)] | FFS | yes | n/a | UE-side beam prediction for BM-Case2 [for inference] is not supported | FFS | FFS | FFS | FFS | FFS: Further partitioning of this FG based on existing and future agreements  FFS: CPU/AIMLPU related information  FFS: candidate values for components | Optional with capability signalling | |
| OPPO [11] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 for inference | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 for inference with UE-side model  3. Maximum number of inference report(s) configured for BM-Case2 per BWP  3a. Maximum number of inference report(s) configured for BM-Case2 across all CCs  4. Maximum number of inference report(s) activated for BM-Case2 per BWP  4a. Maximum number of inference report(s) activated for BM-Case2 across all CCs  5. Maximum number of inference report(s) triggered for BM-Case2 per BWP  5a. Maximum number of inference report(s) triggered for BM-Case2 across all CCs  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  FFS: RS type for Set A  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  7. Supported combinations of the number of resources for Set B and the number of resources for Set A  8. Supported CSI-RS resource types for Set A/B: Periodic CSI-RS, Semi-persistent CSI-RS  9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report  11. Supported maximum number of predicted beams in each predicted time instance  12. Supported maximum number of predicted time instances  13. Supported maximum total number of reported predicted beams for predicted time instances in one report  14. Supported value(s) of time gap between predicted time instances  15. Supported value(s) of setB periodicity  20. Supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, or merged version(s)  FFS: whether/how to report the supported maximum total number of CSI reports across different AI/ML based use-cases  FFS: whether some of components will be reported dynamically instead of as capability  FFS: whether/how to merge this FG with other FG(s) for performance monitoring and/or data collection  FFS: whether/how to report each of supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, or merged version(s)  FFS: whether/how to merge some of above components to report combination(s) of supported values | FFS | yes | n/a | UE-side beam prediction for BM-Case2 for inference is not supported | FFS | FFS | FFS | FFS | ~~FFS: Further partitioning of this FG based on existing and future agreements~~  ~~FFS: CPU/AIMLPU related information~~  ~~FFS: candidate values for components~~ | Optional with capability signalling | |
| LG Electronics [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 [for inference] | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 [for inference] with UE-side model  3. Maximum number of inference report(s) configured for BM-Case2 per BWP  3a. Maximum number of inference report(s) configured for BM-Case2 across all CCs  [4. Maximum number of inference report(s) activated for BM-Case2 per BWP]  [4a. Maximum number of inference report(s) activated for BM-Case2 across all CCs]  [5. Maximum number of inference report(s) triggered for BM-Case2 per BWP]  [5a. Maximum number of inference report(s) triggered for BM-Case2 across all CCs]  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[~~7. Supported combinations of the number of resources for Set B and the number of resources for Set A~~]~~  ~~[~~7a: Supported maximum number of resources for Set B~~]~~  ~~[~~7b: Supported maximum number of resources for Set A~~]~~  8. Supported CSI-RS resource types: Periodic CSI-RS, Semi-persistent CSI-RS]  [9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report]  ~~[10. Supported options for performance monitoring for beam case 2 with UE side model]~~  11. Supported maximum number of predicted beams in each predicted time instance  12. Supported maximum number of predicted time instances  [13. Supported maximum total number of reported predicted beams for predicted time instances in one report]  14. Supported value(s) of time gap between predicted time instances  15. The number of additional symbols, di, between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing predicted beam report, where  i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS  16. The number of additional symbols, di’, between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing predicted beam, where  i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS  ~~[20. Supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, or merged version(s)]~~ | FFS | yes | n/a | UE-side beam prediction for BM-Case2 [for inference] is not supported | FFS | FFS | FFS | FFS | Component 7 candidate values: {FFS: 1/2, 1/4, 1/8, …}  Component 7a candidate values: {FFS: 4, …, 32}  Component 7b candidate values: {FFS: 4, …, 64}  Component 11 candidate values: {FFS: 1, 2, 3, 4}  Component 12 candidate values: {FFS: 1, 2, 4, 8}  Component 14 candidate values: {FFS: 10ms, 20ms, 40ms, 80ms, 160ms}  Component 15 candidate value sets: FFS  Component 16 candidate value sets: FFS  FFS: CPU/AIMLPU related information  FFS: candidate values for components | Optional with capability signalling | |
| Apple [13] | **Proposal 2-4: Keep “for inference” for feature group description for 58-1-4.**  **Proposal 2-5: Introduce components 4, 4a, 5, 5a for 58-1-4.** |
| CMCC [14] | FG 58-1-4 and 58-1-5 share most components with FG 58-1-2 and 58-1-3. In addition, components 12 is supported for BM-Case 2 to assist gNB to provide proper inference configuration during applicable function reporting procedure. With Components 11, Components 13 is not needed since in RAN1 agreement, K value for different predicted time instances is the same.  Components 20 is supported for BM-Case 2. Similar as supported BM-Case 1 sub-usecases component for BM-Case 1, BM-Case 2 sub-usecases component for BM-Case 2 is supported to report in UE capability. So that when gNB transmits inference configuration, gNB can know whether UE supports pure time domain beam prediction or spatial and time domain beam prediction.  ***Proposal 2: Take the following modification (in red) for the feature of Rel-19 AI based beam management:***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 ~~[~~for inference~~]~~ | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 ~~[~~for inference~~]~~ with UE-side model  ~~[2. Supported mapping pattern between set B and set A]~~  ~~[~~3. Maximum number of inference report(s) configured for BM-Case1 per BWP~~]~~  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  [4. Maximum number of inference report(s) activated for BM-Case1 per BWP]  ~~[~~4a. Maximum number of inference report(s) activated for BM-Case1 across all CCs~~]~~  [5. Maximum number of inference report(s) triggered for BM-Case1 per PWB]  ~~[~~5a. Maximum number of inference report(s) triggered for BM-Case1 across all CCs~~]~~  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  ~~FFS: RS type for Set A~~  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[7. Supported combinations of the number of resources for Set B and the number of resources for Set A]~~  ~~[~~7a: Supported maximum number of resources for Set B~~]~~  ~~[~~7b: Supported maximum number of resources for Set A~~]~~  ~~FFS: component 7 or component 7a+7b or 7+7a+7b~~  ~~[~~8. Supported CSI-RS resource types for Set [A/B]: Periodic CSI-RS, Semi-persistent CSI-RS~~]~~  ~~[~~9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report~~]~~  ~~[~~10. Supported options for performance monitoring for beam case 2 with UE side model~~]~~  ~~[~~11. Supported maximum number of predicted beams in each predicted time instance~~]~~  ~~[~~12. Supported maximum number of predicted time instances~~]~~  ~~[13. Supported maximum total number of reported predicted beams for predicted time instances in one report]~~  13. Supported number of AI/ML PU pools for AI/ML features  14. AI/ML PU pool for beam prediction  15. Maximum number of simultaneous AI/ML PUs for beam prediction pool  ~~[~~20. Supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, or merged version(s)~~]~~ | FFS | yes | n/a | UE-side~~d~~ beam prediction for BM Case 2 ~~[~~for inference~~]~~ is not supported | FFS | FFS | FFS | FFS | ~~FFS: Further partitioning of this FG based on existing and future agreements~~  FFS: CPU/AIMLPU related information  FFS: candidate values for components | Optional with capability signalling | |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 [for inference] | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 [for inference] with UE-side model  3. Maximum number of inference report(s) configured for BM-Case2 per BWP  3a. Maximum number of inference report(s) configured for BM-Case2 across all CCs  ~~[4. Maximum number of inference report(s) activated for BM-Case2 per BWP]~~  ~~[4a. Maximum number of inference report(s) activated for BM-Case2 across all CCs]~~  ~~[5. Maximum number of inference report(s) triggered for BM-Case2 per BWP]~~  ~~[5a. Maximum number of inference report(s) triggered for BM-Case2 across all CCs]~~  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[7. Supported combinations of the number of resources for Set B and the number of resources for Set A]~~  [7a: Supported maximum number of resources for Set B]  [7b: Supported maximum number of resources for Set A]  [8. Supported CSI-RS resource types for Set ~~[~~A/B~~]~~: Periodic CSI-RS, Semi-persistent CSI-RS]  [9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report]  ~~[10. Supported options for performance monitoring for beam case 2 with UE side model]~~  11. Supported maximum number of predicted beams in each predicted time instance  12. Supported maximum number of predicted time instances  [13. Supported maximum total number of reported predicted beams for predicted time instances in one report]  [14. Supported value(s) of time gap between predicted time instances and between reference time to the first future time instance]  [15. Supported value(s) of setB periodicity]  [20. Supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, or merged version(s)]  21. values  22. values  23. and values per subcarrier | FFS | yes | n/a | UE-side beam prediction for BM-Case2 [for inference] is not supported | FFS | FFS | FFS | FFS | ~~FFS: CPU/AIMLPU related information~~  ~~FFS: candidate values for components~~  Component 11 candidate values: {1, 2, 4}  Component 12 candidate values: {2, 4, 6, 8}  Component 13 candidate values: {4, 8, 12, 16}  Component 7a candidate values: {16, 32, 64}  Component 7b candidate values: {16, 32, 64}  Component 21 candidate values: INTEGER (1..8)  Component 22 candidate values: INTEGER (0..8)  Component 23 candidate values: for , the corresponding values for and are: {98,196,392,784,1568,3136,6272}, respectively. | Optional with capability signalling | |
| NTT DOCOMO, INC. [16] | At the previous RAN1 meetings, it was agreed to introduce separate FGs for only beam indication and/or predicted RSRP for BM-case2. BM-Case 2 can be categorized into two types: “only temporal beam prediction” and “spatial domain and temporal beam prediction”. As the implementation difficulties are different depending on these types, it is better to differentiate. However, this differentiation can be reported via the combination of minimum required Set B and maximum Set A. Hence, no dedicated component is necessary for this differentiation.  In the temporal beam prediction, the prediction is based on multiple measurement occasions of Set B. According to the UE capability, the required number of measurement occasions could be different. For example, if UE has advanced capability, only one measurement occasion may be sufficient. On the other hand, if UE does not have the advanced capability, UE may need several measurement occasions to predict future beam quality. Hence, the required number of measurement occasions of Set B should be reported by UE.  Also, in the same manner as BM-Case1, the following design should be considered for BM-Case 2 too.   * the combination of the number of Set A and number of Set B should be reported as component * the type should be per UE (or per Band) * Add the components about which APU is CPU\_2 and CPU\_1/CPU\_2 occupations. Restrict the number of candidate values for CPU\_1 and CPU\_2 occupation, e.g., only 3 candidates {0, 1, 8} for CPU\_1 and {0, 2, 4} for CPU\_2.   **Proposal 5: Update FG 58-1-4 and 58-1-5 as follows.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 ~~[~~for inference~~]~~ | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 ~~[~~for inference~~]~~ with UE-side model  3. Maximum number of inference report(s) configured for BM-Case2 per BWP  3a. Maximum number of inference report(s) configured for BM-Case2 across all CCs  ~~[4. Maximum number of inference report(s) activated for BM-Case2 per BWP]~~  ~~[4a. Maximum number of inference report(s) activated for BM-Case2 across all CCs]~~  ~~[5. Maximum number of inference report(s) triggered for BM-Case2 per BWP]~~  ~~[5a. Maximum number of inference report(s) triggered for BM-Case2 across all CCs]~~  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[7. Supported combinations of the number of resources for Set B and the number of resources for Set A]~~  ~~[7a: Supported maximum number of resources for Set B]~~  ~~[7b: Supported maximum number of resources for Set A]~~  ~~[~~8. Supported CSI-RS resource types for Set [A/B]: Periodic CSI-RS, Semi-persistent CSI-RS~~]~~  ~~[~~9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report~~]~~  ~~[10. Supported options for performance monitoring for beam case 2 with UE side model]~~  11. Supported maximum number of predicted beams in each predicted time instance  12. Supported maximum number of predicted time instances  ~~[13. Supported maximum total number of reported predicted beams for predicted time instances in one report]~~  ~~[~~20. Supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, ~~or merged version(s)]~~  21. A list of supported combinations, each combination is {minimum required number of SSB/CSI-RS resources to be measured, maximum number of SSB/CSI-RS resources to be predicted}  22. Required minimum number of measurement occasions of Set B  23. Index about which APU resource pool is CPU\_2.  24. Value of CPU\_1 occupation.  25. Value of CPU\_2 occupation. | 2-24, 58-0-1 | yes | n/a | UE-side beam prediction for BM-Case2 ~~[~~for inference~~]~~is not supported | Per UE | No | No |  | Component 11 Candidate value set: {1, 2, 3, 4}  Component 12 candidate value set: {1, 2, 4, 8}  Candidate value of the minimum required number of SSB/CSI-RS resources to be measured in Component 21: {4, 8, 16, 32}  Candidate value of the maximum number of SSB/CSI-RS resources to be predicted in Component 21: {16, 32, 64, 128}  Component 22 Candidate value set: {1, 2, 4}  Candidate values for Component 23: {1,2}  Candidate values for component 24: {0, 1, 8}  Candidate values for component 25: {0, 2, 4} | Optional with capability signalling | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. NR\_AIML\_air | 58-1-5 | UE-side beam prediction for BM-Case2 with predicted RSRP [for inference] | 1. Support of beam prediction, reporting of predicted beams and predicted RSRP, for BM-Case2 (spatial and time domain beam prediction) [for inference] | 58-1-4 | yes | n/a | UE-side beam prediction for BM-Case2 [for inference] is not supported | FFS | FFS | FFS | FFS | FFS: CPU/AIMLPU related information | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Ericsson [2] | The values of X1/X2/Y1/Y2 need to be addressed to complete the feature. To reduce the complexity for the NW to handle many different combinations of PU occupancies, a limited number of values should be supported. Two unique values for X1/X2/Y1/Y2 are proposed as a starting point, the exact value is based on the estimated complexity for BM-Case 1 and BM-Case2. Given the increased model input/output of BM-Case 2, it likely should have larger complexity.  Furthermore, the following proposed way forward was endorsed in RANP #108.   |  | | --- | | Proposal   * A UE can report support for N (up to 2) AI/ML PU pools for AI/ML features   - For each of the N AI/ML PU pools, UE reports the maximum number of simultaneous AI/ML PUs, respectively.  - If N = 2, for each AI/ML use case feature, UE reports which AI/ML PU pool it belongs to. |   This means that when the UE supports N=2 APU pools, then the APU pool index associated with AI/ML UE feature needs to be included as part of the capability report.   1. For the values of X1/X2 and Y1/Y2, support a limited number of values. Assume X1/X2/Y1/Y2 can take 2 unique values as a starting point. 2. As part of FGs 58-1-2, 58-1-3, 58-1-4, and 58-1-5, introduce APU pool index associated with the FG when 2 APU pools are supported by the UE.   Regarding the values of d and d’, if a large value is supported, the NW might receive outdated predictions at least for BM-Case 1. Moreover, it could occupy the PU resources an extensive amount of time, limiting the NW flexibility to configure other CSI-reports. Our view is that the extension should not support large values of d and d’.   1. For the values of d and d’, do not support large values since it would reduce the usefulness of the predictions, in particular for BM-Case 1, and would limit the NW flexibility to configure other CSI reports.   For the UE-side beam prediction for BM-Case 1 and BM-Case 2, the agreed UE feature definition is almost complete. Only a clarification is needed that the UE should also support the performance monitoring as part of the feature.   1. For components of FG 58-1-2, FG 58-1-3, FG 58-1-4 and FG 58-1-5 in addition to the agreed components, add the component: “Support UE-assisted performance monitoring.” |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-5 | UE-side beam prediction for BM-Case2 with predicted RSRP | 1. Support of beam prediction, reporting of predicted beams and predicted RSRP, for BM-Case2 (spatial and time domain beam prediction) | 58-1-4 | yes | n/a | UE-side beam prediction for BM-Case2 is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling | |
| CATT/CICTCI [4] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-5 | UE-side beam prediction for BM-Case2 with predicted RSRP ~~[~~for inference~~]~~ | 1. Support of beam prediction, reporting of predicted beams and predicted RSRP, for BM-Case2 (spatial and time domain beam prediction) ~~[~~for inference~~]~~ | 58-1-4 | yes | n/a | UE-side beam prediction for BM-Case2 ~~[~~for inference~~]~~ is not supported | FFS | FFS | FFS | FFS | FFS: CPU/AIMLPU related information | Optional with capability signalling | |
| Huawei/HiSilicon [5] | **Notation of 58-1-4/58-1-5**  Similar to our analysis to 58-1-2/3, the “for inference” can be removed.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-5 | UE-side beam prediction for BM-Case2 with predicted RSRP ~~[for inference]~~ | 1. Support of beam prediction, reporting of predicted beams and predicted RSRP, for BM-Case2 (spatial and time domain beam prediction) ~~[for inference]~~ | 58-1-4 | yes | n/a | UE-side beam prediction for BM-Case2 ~~[for inference]~~ is not supported | FFS: CPU/AIMLPU related information | Optional with capability signalling | |
| Vivo [6] | For FG 58-1-2, it is acceptable to retain the purpose as "for inference", since the UE inference feature is designated exclusively for this function and cannot be repurposed for other purposes such as data collection or monitoring.   1. For components of FG 58-1-2, FG 58-1-3, FG 58-1-4 and FG 58-1-5, support to retain the purpose as "for inference".  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-5 | UE-side beam prediction for BM-Case2 with predicted RSRP ~~[for inference]~~ for inference | 1. Support of beam prediction, reporting of predicted beams and predicted RSRP, for BM-Case2 (spatial and time domain beam prediction) ~~[for inference]~~ for inference | 58-1-4 | yes | UE-side beam prediction for BM-Case2 ~~[for inference]~~ for inference is not supported | FFS: CPU/AIMLPU related information | |
| Xiaomi [7] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-5 | UE-side beam prediction for BM-Case2 with predicted RSRP for inference | 1. Support of beam prediction, reporting of predicted beams and predicted RSRP, for BM-Case2 (spatial and time domain beam prediction) [for inference]  2. Maximum number of future time instance  3. Supported maximum number of predicted beams with RSRP in each predicted time instance  4. Supported maximum total number of predicted beams with RSRP for predicted time instances in one report  5. Number of occupied CPU  6. Number of occupied APU  6a. APU pool index.  FFS: other components | 58-1-4 | yes | n/a | UE-side beam prediction for BM-Case2 for inference is not supported | FFS | FFS | FFS | FFS | FFS: Further partitioning of this FG based on existing and future agreements  FFS: CPU/AIMLPU related information | Optional with capability signalling | |
| ZTE Corporation/Sanechips [8] | Regarding the components of FG58-1-2~FG58-1-5, the “FFS: CPU/AIMLPU related information” can be addressed by allowing the UE to report the occupied CPU and/or AIMLPU.  ***Proposal 4****:* *Regarding the components of FG58-1-2~FG58-1-5, UE reports the occupied CPU and/or AIMLPU.* |
| Samsung [9] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-5 | UE-side beam prediction for BM-Case2 with predicted RSRP ~~[for inference]~~ | 1. Support of beam prediction, reporting of predicted beams and predicted RSRP, for BM-Case2 (spatial and time domain beam prediction) ~~[for inference]~~ | 58-1-4 | yes | n/a | UE-side beam prediction for BM-Case2 ~~[for inference]~~ is not supported | FFS | FFS | FFS | FFS | ~~FFS: CPU/AIMLPU related information~~ | Optional with capability signalling | |
| Ofinno [10] |  |
| OPPO [11] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-5 | UE-side beam prediction for BM-Case2 with predicted RSRP for inference | 1. Support of beam prediction, reporting of predicted beams and predicted RSRP, for BM-Case2 (spatial and time domain beam prediction) for inference  2. Maximum number of future time instance  FFS: other components | 58-1-4 | yes | n/a | UE-side beam prediction for BM-Case2 [for inference] is not supported | FFS | FFS | FFS | FFS | ~~FFS: Further partitioning of this FG based on existing and future agreements~~  ~~FFS: CPU/AIMLPU related information~~ | Optional with capability signalling | |
| LG Electronics [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-5 | UE-side beam prediction for BM-Case2 with predicted RSRP [for inference] | 1. Support of beam prediction, reporting of predicted beams and predicted RSRP, for BM-Case2 (spatial and time domain beam prediction) [for inference]  2. Supported maximum number of predicted beams with RSRP in each predicted time instance  3. Supported maximum number of predicted time instances  [4. Supported maximum total number of predicted beams with RSRP for predicted time instances in one report]  5. Supported value(s) of time gap between predicted time instances  6. The number of additional symbols, di, between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing predicted beam report, where  i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS  7. The number of additional symbols, di’, between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing predicted beam, where  i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS | 58-1-4 | yes | n/a | UE-side beam prediction for BM-Case2 [for inference] is not supported | FFS | FFS | FFS | FFS | Component 2 candidate values: {FFS: 1, 2, 3, 4}  Component 3 candidate values: {FFS: 1, 2, 4, 8}  Component 5 candidate values: {FFS: 10ms, 20ms, 40ms, 80ms, 160ms}  Component 6 candidate value sets: FFS  Component 7 candidate value sets: FFS  FFS: CPU/AIMLPU related information | Optional with capability signalling | |
| Apple [13] | **Proposal 2-6: Introduce components 4, 4a, 5, 5a for 58-1-5.** |
| CMCC [14] | FG 58-1-4 and 58-1-5 share most components with FG 58-1-2 and 58-1-3. In addition, components 12 is supported for BM-Case 2 to assist gNB to provide proper inference configuration during applicable function reporting procedure. With Components 11, Components 13 is not needed since in RAN1 agreement, K value for different predicted time instances is the same.  Components 20 is supported for BM-Case 2. Similar as supported BM-Case 1 sub-usecases component for BM-Case 1, BM-Case 2 sub-usecases component for BM-Case 2 is supported to report in UE capability. So that when gNB transmits inference configuration, gNB can know whether UE supports pure time domain beam prediction or spatial and time domain beam prediction.  ***Proposal 2: Take the following modification (in red) for the feature of Rel-19 AI based beam management:***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-5 | UE-side beam prediction for BM-Case2 with predicted RSRP ~~[~~for inference~~]~~ | 1. Support of beam prediction, reporting of predicted beams and predicted RSRP, for BM-Case2 (spatial and time domain beam prediction) ~~[~~for inference~~]~~  ~~[2. Maximum number of future time instance]~~  ~~FFS: other components~~ | 58-1-4 | yes | n/a | UE-side beam prediction for BM-Case2 [for inference] is not supported | FFS | FFS | FFS | FFS | ~~FFS: Further partitioning of this FG based on existing and future agreements~~  FFS: CPU/AIMLPU related information | Optional with capability signalling | |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-5 | UE-side beam prediction for BM-Case2 with predicted RSRP [for inference] | 1. Support of beam prediction, reporting of predicted beams and predicted RSRP, for BM-Case2 (spatial and time domain beam prediction) [for inference] | 58-1-4 | yes | n/a | UE-side beam prediction for BM-Case2 [for inference] is not supported | FFS | FFS | FFS | FFS | ~~FFS: CPU/AIMLPU related information~~ | Optional with capability signalling | |
| NTT DOCOMO, INC. [16] | At the previous RAN1 meetings, it was agreed to introduce separate FGs for only beam indication and/or predicted RSRP for BM-case2. BM-Case 2 can be categorized into two types: “only temporal beam prediction” and “spatial domain and temporal beam prediction”. As the implementation difficulties are different depending on these types, it is better to differentiate. However, this differentiation can be reported via the combination of minimum required Set B and maximum Set A. Hence, no dedicated component is necessary for this differentiation.  In the temporal beam prediction, the prediction is based on multiple measurement occasions of Set B. According to the UE capability, the required number of measurement occasions could be different. For example, if UE has advanced capability, only one measurement occasion may be sufficient. On the other hand, if UE does not have the advanced capability, UE may need several measurement occasions to predict future beam quality. Hence, the required number of measurement occasions of Set B should be reported by UE.  Also, in the same manner as BM-Case1, the following design should be considered for BM-Case 2 too.   * the combination of the number of Set A and number of Set B should be reported as component * the type should be per UE (or per Band) * Add the components about which APU is CPU\_2 and CPU\_1/CPU\_2 occupations. Restrict the number of candidate values for CPU\_1 and CPU\_2 occupation, e.g., only 3 candidates {0, 1, 8} for CPU\_1 and {0, 2, 4} for CPU\_2.   **Proposal 5: Update FG 58-1-4 and 58-1-5 as follows.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-5 | UE-side beam prediction for BM-Case2 with predicted RSRP ~~[~~for inference~~]~~ | 1. Support of beam prediction, reporting of predicted beams and predicted RSRP, for BM-Case2 (spatial and time domain beam prediction) ~~[~~for inference~~]~~ | 58-1-4 | yes | n/a | UE-side beam prediction for BM-Case2 ~~[~~for inference~~]~~is not supported | Per UE | No | No |  | ~~FFS: CPU/AIMLPU related information~~ | Optional with capability signalling | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. NR\_AIML\_air | 58-1-7 | Data collection for UE-side beam prediction [for BM case 1] | 1. Support of data collection for UE-side beam prediction [for BM case 1]  2. Support of SS/PBCH block and 1-port CSI-RS based RSRP measurements for measurement RS resource sets (Set B and Set A) for data collection  [3. Supported sub-use cases: {‘Set B equal to Set A’, ‘Set B subset of Set A’,’Set B not a subset of Set A’}]  [6: Supported maximum number of resources for Set B]  [7: Supported maximum number of resources for Set A]  8. Support of SSB as RS type for Set B  9. Support of CSI-RS as RS type for Set B  10. Support of SSB as RS type for Set A  11. Support of CSI-RS as RS type for Set A | FFS | yes | n/a | Data collection for UE-side beam prediction is not supported [for BM case 1] | FFS | FFS | FFS | FFS | Note: it is up to RAN2 whether this FG is merged into data collection FG defined by RAN2 | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Ericsson [2] |  |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-7 | Data collection for UE-side beam prediction | 1. Support of data collection for UE-side beam prediction  2. Support of SS/PBCH block and 1-port CSI-RS based RSRP measurements for measurement RS resource sets (Set B and Set A) for data collection  3. Supported sub-use cases}  6: Supported maximum number of resources for Set B  7: Supported maximum number of resources for Set A  8. Support of SSB as RS type for Set B  9. Support of CSI-RS as RS type for Set B  10. Support of SSB as RS type for Set A  11. Support of CSI-RS as RS type for Set A | FFS | yes | n/a | Data collection for UE-side beam prediction is not supported | FFS | FFS | FFS | FFS | Note: it is up to RAN2 whether this FG is merged into data collection FG defined by RAN2  Component 3: : {‘Set B equal to Set A’, ‘Set B subset of Set A’,’Set B not a subset of Set A’}  Component 6 : {4, 8, 16, 32, 64}  Component 7 : {8, 16, 32, 48, 64} | Optional with capability signalling | |
| CATT/CICTCI [4] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-7 | Data collection for UE-side beam prediction ~~[for BM case 1]~~ | 1. Support of data collection for UE-side beam prediction ~~[for BM case 1]~~  2. Support of SS/PBCH block and 1-port CSI-RS based RSRP measurements for measurement RS resource sets (Set B and Set A) for data collection  ~~[~~3. Supported sub-use cases: {‘Set B equal to Set A’, ‘Set B subset of Set A’,’Set B not a subset of Set A’}~~]~~  ~~[~~6: Supported maximum number of resources for Set B~~]~~  ~~[~~7: Supported maximum number of resources for Set A~~]~~  8. Support of SSB as RS type for Set B  9. Support of CSI-RS as RS type for Set B  10. Support of SSB as RS type for Set A  11. Support of CSI-RS as RS type for Set A | ~~FFS~~ | yes | n/a | Data collection for UE-side beam prediction is not supported ~~[for BM case 1]~~ | FFS | FFS | FFS | FFS | Note: it is up to RAN2 whether this FG is merged into data collection FG defined by RAN2 | Optional with capability signalling | |
| Huawei/HiSilicon [5] | **Components**   * Component 6/7: For data collection, UE needs to measure Set B to obtain model input and measure Set A to obtain the label. For Component 7, to enable sufficient number of overall Tx beams, it is proposed to set the max number of CSI-RS resources for Set A as up to 256. Accordingly, for Set B, it is proposed to set the max number of CSI-RS resources for Set B as up to 64. * Component 3: The candidate cases include {‘Set B equal to Set A’, ‘Set B subset of Set A’,’Set B not a subset of Set A’}. From our view, UE capability of supporting BM-Case 1 and BM-Case 2 should be separated also from the data collection perspective, since it may impact the configuration on the resources of Set B and Set A by gNB. E.g., from NW perspective, the flavors on the resources of Set B and Set A (e.g., number of beams, periodicity of Set B/Set A, time offset between Set B and Set A, etc.) may be different between BM-Case 1 and BM-Case 2. To ensure the aligned configuration between training and inference, gNB should be clear on the intended BM-Case 1 and BM-Case 2 by UE early in the training phase.   According to the discussion for Component 3, FG 58-1-7 should be applied for BM-Case 1, and an additional FG, namely 58-1-7a, should be introduced for BM-Case 2.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-7 | Data collection for UE-side beam prediction ~~[~~for BM case 1~~]~~ | 1. Support of data collection for UE-side beam prediction ~~[~~for BM case 1~~]~~  2. Support of SS/PBCH block and 1-port CSI-RS based RSRP measurements for measurement RS resource sets (Set B and Set A) for data collection  [3. Supported sub-use cases: {~~‘Set B equal to Set A’,~~ ‘Set B subset of Set A’,’Set B not a subset of Set A’}]  ~~[~~6: Supported maximum number of resources for Set B~~]~~  ~~[~~7: Supported maximum number of resources for Set A~~]~~  8. Support of SSB as RS type for Set B  9. Support of CSI-RS as RS type for Set B  10. Support of SSB as RS type for Set A  11. Support of CSI-RS as RS type for Set A | FFS | yes | n/a | Data collection for UE-side beam prediction is not supported ~~[~~for BM case 1~~]~~ | Note: it is up to RAN2 whether this FG is merged into data collection FG defined by RAN2  Component 6 candidate values: {16, 32, 64}  Component 7 candidate values: {32, 64, 128, 256} | Optional with capability signalling | | 58. NR\_AIML\_air | 58-1-7a | Data collection for UE-side beam prediction for BM case 2 | 1. Support of data collection for UE-side beam prediction for BM case 2  2. Support of SS/PBCH block and 1-port CSI-RS based RSRP measurements for measurement RS resource sets (Set B and Set A) for data collection  [3. Supported sub-use cases: {‘Set B equal to Set A’, ‘Set B subset of Set A’,’Set B not a subset of Set A’}]  4: Supported maximum number of resources for Set B  5: Supported maximum number of resources for Set A | FFS | yes | n/a | Data collection for UE-side beam prediction is not supported for BM case 2 | Note: it is up to RAN2 whether this FG is merged into data collection FG defined by RAN2  Component 6 candidate values: {16, 32, 64}  Component 7 candidate values: {32, 64, 128, 256} | Optional with capability signalling | |
| Vivo [6] | For FG 58-1-7, retention of BM Case 1 is mandatory, since BM Case 2 necessitates auxiliary configuration parameters, such as periodicity, time gap. Besides, consistent with the inference rationale, the UE shall report supported maximum number of resources for Set B, supported maximum number of resources for Set A and supported minimum number of resources for Set B to enable effective network measurement data acquisition,   1. For components of FG 58-1-7 in addition to the agreed components:  * **Remove square brackets of [for BM Case 1]** * **Supported maximum number of resources for Set B** * **Supported maximum number of resources for Set A** * **Supported minimum number of resources for Set B**  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-7 | Data collection for UE-side beam prediction ~~[for BM case 1]~~ for BM case 1 | 1. Support of data collection for UE-side beam prediction ~~[for BM case 1]~~ for BM case 1  2. Support of SS/PBCH block and 1-port CSI-RS based RSRP measurements for measurement RS resource sets (Set B and Set A) for data collection  [3. Supported sub-use cases: {‘Set B equal to Set A’, ‘Set B subset of Set A’,’Set B not a subset of Set A’}]  6: Supported maximum number of resources for Set B  6a: Supported minimum number of resources for Set B  7: Supported maximum number of resources for Set A  8. Support of SSB as RS type for Set B  9. Support of CSI-RS as RS type for Set B  10. Support of SSB as RS type for Set A  11. Support of CSI-RS as RS type for Set A | FFS | yes | Data collection for UE-side beam prediction is not supported ~~[for BM case 1]~~ for BM case 1 | Note: it is up to RAN2 whether this FG is merged into data collection FG defined by RAN2 | |
| Xiaomi [7] |  |
| ZTE Corporation/Sanechips [8] | Regarding FG58-1-7, we propose the following updates.   * We propose to remove “[for BM case 1]” in the name and component 1. No matter whether it is Beam case 1 or Beam case 2, the UE behaviour is the same, i.e., measuring reference signal and derive the RSRP. * We propose to remove the component 3. Similar logic as above, UE behaviour is the same no matter whether Set B is a subset of the Set A or not.   ***Proposal 6****: Regarding FG58-1-7, we propose the following*   * *Remove the “*[for BM case 1]*” in the name and component 1* * *Remove component 3* |
| Samsung [9] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-7 | Data collection for UE-side beam prediction ~~[for BM case 1]~~ | 1. Support of data collection for UE-side beam prediction ~~[for BM case 1]~~  2. Support of SS/PBCH block and ~~[~~1-port~~]~~ CSI-RS based RSRP measurements for measurement RS resource sets (Set B and Set A) for data collection  [3. Supported sub-use cases: {‘Set B equal to Set A’, ‘Set B subset of Set A’,’Set B not a subset of Set A’}]  [6: Supported maximum number of resources for Set B  7: Supported maximum number of resources for Set A]  8. Support of SSB as RS type for Set B  9. Support of CSI-RS as RS type for Set B  10. Support of SSB as RS type for Set A  11. Support of CSI-RS as RS type for Set A | FFS | yes | n/a | Data collection for UE-side beam prediction is not supported ~~[for BM case 1]~~ | FFS | FFS | FFS | FFS | Note: it is up to RAN2 whether this FG is merged into data collection FG defined by RAN2 | Optional with capability signalling | |
| Ofinno [10] |  |
| OPPO [11] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-7 | Data collection for UE-side beam prediction for BM case 1 | 1. Support of data collection for UE-side beam prediction for BM case 1  2. Support of SS/PBCH block and [1-port] CSI-RS based RSRP measurements for measurement RS resource sets (Set B and Set A) for data collection  [3. Supported sub-use cases: {‘Set B equal to Set A’, ‘Set B subset of Set A’,’Set B not a subset of Set A’}]  FFS: components for maximum number of resources  6: Supported maximum number of resources for Set B  7: Supported maximum number of resources for Set A  8. Support of SSB as RS type for Set B  9. Support of CSI-RS as RS type for Set B  10. Support of SSB as RS type for Set A  11. Support of CSI-RS as RS type for Set A | FFS | yes | n/a | Data collection for UE-side beam prediction is not supported for BM case 1 | FFS | FFS | FFS | FFS | ~~FFS: separate rows/FGs for BM case 1 and BM case 2~~  ~~Note: it is up to RAN2 whether this FG is merged into data collection FG defined by RAN2~~ | Optional with capability signalling | |
| LG Electronics [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-7 | Data collection for UE-side beam prediction ~~[for BM case 1]~~ | 1. Support of data collection for UE-side beam prediction ~~[for BM case 1]~~  2. Support of SS/PBCH block and 1-port CSI-RS based RSRP measurements for measurement RS resource sets (Set B and Set A) for data collection  ~~[3. Supported sub-use cases: {‘Set B equal to Set A’, ‘Set B subset of Set A’,’Set B not a subset of Set A’}]~~  [6: Supported maximum number of resources for Set B]  [7: Supported maximum number of resources for Set A]  8. Support of SSB as RS type for Set B  9. Support of CSI-RS as RS type for Set B  10. Support of SSB as RS type for Set A  11. Support of CSI-RS as RS type for Set A | FFS | yes | n/a | Data collection for UE-side beam prediction is not supported ~~[for BM case 1]~~ | FFS | FFS | FFS | FFS | Note: it is up to RAN2 whether this FG is merged into data collection FG defined by RAN2 | Optional with capability signalling | |
| Apple [13] | **Proposal 2-7: Introduce components 6 and 7 for 58-1-7.**  **Proposal 2-8: keep “for BM case 1” for the feature group description for 58-1-7.** |
| CMCC [14] | FG 58-1-7 can apply for BM-Case 1 and BM-Case 2. Component 3,6,7 are supported to assist gNB to transmit proper data collection configuration.  ***Proposal 3: Take the following modification (in red) for the feature of Rel-19 AI based beam management:***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-7 | Data collection for UE-side beam prediction ~~[for BM case 1]~~ | 1. Support of data collection for UE-side beam prediction ~~[for BM case 1]~~  2. Support of SS/PBCH block and ~~[~~1-port~~]~~ CSI-RS based RSRP measurements for measurement RS resource sets (Set B and Set A) for data collection  ~~[~~3. Supported sub-use cases: {‘Set B equal to Set A’, ‘Set B subset of Set A’,’Set B not a subset of Set A’}~~]~~  ~~FFS: components for maximum number of resources~~  ~~[~~6: Supported maximum number of resources for Set B  7: Supported maximum number of resources for Set A~~]~~  8. Support of SSB as RS type for Set B  9. Support of CSI-RS as RS type for Set B  10. Support of SSB as RS type for Set A  11. Support of CSI-RS as RS type for Set A | FFS | yes | n/a | Data collection for UE-side beam prediction is not supported ~~[for BM case 1]~~ | FFS | FFS | FFS | FFS | ~~FFS: separate rows/FGs for BM case 1 and BM case 2~~  Note: it is up to RAN2 whether this FG is merged into data collection FG defined by RAN2 | Optional with capability signalling | |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-7 | Data collection for UE-side beam prediction ~~[for BM case 1]~~ | 1. Support of data collection for UE-side beam prediction ~~[for BM case 1]~~  2. Support of SS/PBCH block and 1-port CSI-RS based RSRP measurements for measurement RS resource sets (Set B and Set A) for data collection  ~~[3. Supported sub-use cases: {‘Set B equal to Set A’, ‘Set B subset of Set A’,’Set B not a subset of Set A’}]~~  ~~[6: Supported maximum number of resources for Set B~~  ~~7: Supported maximum number of resources for Set A]~~  8. Support of SSB as RS type for Set B  9. Support of CSI-RS as RS type for Set B  10. Support of SSB as RS type for Set A  11. Support of CSI-RS as RS type for Set A | FFS | yes | n/a | Data collection for UE-side beam prediction is not supported ~~[for BM case 1]~~ | FFS | FFS | FFS | FFS | Note: it is up to RAN2 whether this FG is merged into data collection FG defined by RAN2 | Optional with capability signalling | |
| NTT DOCOMO, INC. [16] | At the previous RAN1 meetings, it was agreed to introduce FG for data collection for UE-sided beam prediction. As this feature is basically the measurement of RSRP, the prerequisite FG can be FG 2-24. Also, this feature is not related to CA, so the type should be per UE (or per band). We don’t think it is necessary to highlight the usage of the collected data since it is up to UE or UE-side implementation. Therefore, the “for BM case 1” parts can be removed.  **Proposal 3: Update FG 58-1-7 as follows.**   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-7 | Data collection for UE-side beam prediction ~~[for BM case 1]~~ | 1. Support of data collection for UE-side beam prediction ~~[for BM case 1]~~  2. Support of SS/PBCH block and 1-port CSI-RS based RSRP measurements for measurement RS resource sets (Set B and Set A) for data collection  ~~[~~3. Supported sub-use cases: {‘Set B equal to Set A’, ‘Set B subset of Set A’,’Set B not a subset of Set A’}~~]~~  ~~[~~6: Supported maximum number of resources for Set B~~]~~  ~~[~~7: Supported maximum number of resources for Set A~~]~~  8. Support of SSB as RS type for Set B  9. Support of CSI-RS as RS type for Set B  10. Support of SSB as RS type for Set A  11. Support of CSI-RS as RS type for Set A | 2-24 | yes | n/a | Data collection for UE-side beam prediction is not supported ~~[for BM case 1]~~ | Per UE | No | No |  | Optional with capability signalling | |

**Other**

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| --- | --- |
| Company | Summary |
| Ericsson [2] |  |
| Nokia [3] |  |
| CATT/CICTCI [4] |  |
| Huawei/HiSilicon [5] |  |
| Vivo [6] |  |
| Xiaomi [7] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-6 | Performance monitoring for UE-sided model | 1. Support of performance monitoring with RS-PAI of AI/ML model for beam prediction.  2. Maximum total number of the configured CSI-RS resources for monitoring RS resource set  3. Maximum number of periodic CSI report setting per BWP for monitoring reporting  4. Maximum number of aperiodic CSI report setting per BWP for monitoring reporting  5. Maximum number of semi-persistent CSI report setting per BWP for monitoring reporting  6. Supported values of configured transmission occasion N  7. Supported sub usecase of monitoring RS resource set C: { setC-equals-to-setA, setC-subset-of-setA, both}  8.Supported periodicity of performance monitoring report | 58-1-2,58-1-3,58-1-4, or 58-1-5 | yes | n/a | Performance monitoring for UE-sided model is not supported | FFS | FFS | FFS | FFS | FFS: Further partitioning of this FG based on existing and future agreements  FFS: separate rows/FGs for case 1 and case 2 | Optional with capability signalling | | 58. NR\_AIML\_air | 58-1-8 | Consistency between model training and inference | 1.Supported maximum number of associated IDs | FFS | yes | n/a | Consistency between model training and inference is not supported | FFS | FFS | FFS | n/a |  | Optional with capability signalling | | 58. NR\_AIML\_air | 58-1-9 | APU for AI/ML based processing | 1.Supported number of APU pools for AI based processing  2. Supported maximum number of APUs for each APU pool. | FFS | yes | n/a | APU for AI/ML based processing is not supported | FFS | FFS | FFS | n/a | candidate values for Component 1: {1, 2} | Optional with capability signalling | |
| ZTE Corporation/Sanechips [8] |  |
| Samsung [9] |  |
| Ofinno [10] |  |
| OPPO [11] |  |
| LG Electronics [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-1-6 | Performance monitoring for UE-side beam prediction | 1. Support of performance monitoring of UE-side beam prediction. | FFS: X-1-2, [X-1-3], X-1-4, [X-1-5] | yes | n/a | Performance monitoring for UE-sided beam prediction is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling | |
| Apple [13] |  |
| CMCC [14] |  |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-8 | **Monitoring for UE-side beam prediction** | 1. Supported option(s) for performance monitoring for beam prediction with UE side model.  2. Supported maximum number of resources for performance monitoring set | FFS | yes | n/a | Monitoring for UE-side beam prediction is not supported | FFS | FFS | FFS | FFS | Component 2 candidate values: {16, 32, 64} | Optional with capability signalling | |
| NTT DOCOMO, INC. [16] | Performance monitoring can be categorized into NW side performance monitoring and UE assisted performance monitoring.  The feature used for NW side performance monitoring is identical to the one for NW side beam prediction. Hence, the UE capability discussion for performance monitoring can focus on only UE assisted performance monitoring. For UE assisted performance monitoring, a new FG should be introduced. Based on the above agreement for this feature, the following FG should be introduced for UE assisted performance monitoring.  **Proposal 6: Introduce the following FG for UE assisted performance monitoring.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-1-6 | UE-assisted performance monitoring for UE-sided beam prediction | 1. Support of UE-assisted performance monitoring  2. Supported BM-Case(s)  3. Maximum value N for monitoring window (number of monitoring instances)  4. Support of M =1, 2  5. Maximum value of minimal slot offset X | 58-1-2, 58-1-4 | yes | n/a | UE-assisted performance monitoring for UE-sided beam prediction is not supported | Per UE | No | No |  | Component 2 candidate value set: {BM-Case1, BM-Case2}  Component 3 Candidate value set: {1, 2, 4, 8, 16}  Component 5 Candidate value set: {1, 2, 4} | Optional with capability signalling | |

## Specification support for positioning accuracy enhancement

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| 58. NR\_AIML\_Air | 58-2-1 | UE-based positioning Case 1 [for inference] | Indicates support of UE-based positioning Case 1 [for inference] | FFS | N/A | N/A | UE-based positioning Case 1 [for inference] is not supported | FFS | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signalling |

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| Company | Summary |
| Ericsson [2] | For the positioning use case, RAN1 agreed to introduce an FG for the support of UE based positioning Case 1. However, in legacy, RAN2 specified methods capabilities, as can be seen in 38.306 and 38.822.  Another open issue was whether to limit the FG to inference. Case 1 is not supported by new specification text for data collection (i.e., training data collection is OTT in Rel-19), but includes LCM with basic monitoring support. The model inference phase includes the procedure where the UE signals the LMF with monitoring outcome, as agreed in RAN1#120b:   |  | | --- | | Agreement (RAN1#119)  For model performance monitoring of AI/ML positioning Case 1, support at least:   * Option A. The target UE side performs monitoring metric calculation.   + The target UE may signal the monitoring outcome to the LMF.   + FFS: content of monitoring outcome   Agreement (RAN1#120b)  For model performance monitoring of AI/ML positioning Case 1, “FFS: content of monitoring outcome” in RAN1#119 agreement is resolved by:   * the content of monitoring outcome includes at least an indication that the target UE cannot perform the Case 1 positioning method. |   Since AI/ML method involves a list of LCM procedures beyond model inference, it should be described clearly that support of Case 1 includes all necessary LCM procedures, including at least model inference, model performance monitoring, functionality activation/deactivation. We also note that the FG is not an L1 feature group, and can be up to RAN2 to specify.   1. Move FG 58-2-1 to L2 Feature groups, the same as other positioning methods. 2. Remove the reference to inference in the name of FG 58-1-2 and add the following as components of FG 58-2-1:    1. Support reporting the monitoring outcome with an indication that the target UE cannot perform the Case 1 positioning method.    2. Support LMF initiated activation / deactivation of UE-based positioning Case 1.    3. Support reporting the location estimate as generated by UE-based positioning Case 1.   Finally, since this FG is a core function support FG (typically signalled by L2), it should not have any dependency from other L1 FGs. This FG should also be a per UE FG, with other FGs used to differentiate which bands/BCs are supported.   1. Remove FFS on FG dependencies for 58-2-1 and set it to “N/A”. 2. Set FG 58-2-1 as “per UE”.   For model performance monitoring, in RAN1#118, it was concluded that Option A-4 does not need to be further discussed. In RAN1#120bis, Option A-1/2/3 were discussed and informally concluded. It is understood that the agreement of RAN1#119 was sufficient, i.e., Option A-1/2/3 are supported; the existing signaling can be reused, and no further discussion is needed. Thus Option A-1/2/3 does not require introducing a new FG.  In RAN1#121, the following was concluded on Option B:   |  | | --- | | Conclusion  For model performance monitoring of AI/ML positioning Case 1, for model performance monitoring metric calculation in label-based model monitoring,   * There is no consensus in RAN1 to support Option B (including Option B-1 and B-2). |   Since Option B is not supported, there is no need to introduce a new FG for performance monitoring.   1. UE-based positioning Case 1 does not require a separate FG for model performance monitoring. Include performance monitoring as a component of Case 1 main FG 58-2-1. |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-1 | UE-based positioning Case 1 | Indicates support of UE-based positioning Case 1 | FFS | N/A | N/A | UE-based positioning Case 1 is not supported | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signalling | |
| CATT/CICTCI [4] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-1 | UE-based positioning Case 1 ~~[~~for inference~~]~~ | Indicates support of UE-based positioning Case 1 ~~[~~for inference~~]~~ | ~~FFS~~ At least one of 13-3, 13-3a, 13-3b | N/A | N/A | UE-based positioning Case 1 ~~[~~for inference~~]~~ is not supported | FFS | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signalling | |
| Huawei/HiSilicon [5] | **Notation of 58-2-1**  Since UE-based positioning Case 1 is the only positioning UE feature in Rel-19, it is fine not to add “for inference”. We are also fine to add it to be aligned with other UE features.  **Prerequisite**  Regarding the prerequisite, the UE needs to support the reception of DL-PRS resources and be able to process DL-PRS. But the common DL PRS Processing Capability in FG 13-1 has the Field name and Parent IE in TS 38.331 as listed in the below table:   |  |  | | --- | --- | | Field name in TS 38.331 | Parent IE in TS 38.331 | | *1 supportedBandwidthPRS-r16*  *2 dl-PRS-BufferType-r16*  *3 durationOfPRS-Processing-r16*  *4 maxNumOfDL-PRS-ResProcessedPerSlot-r16* | *PRS-ProcessingCapabilityPerBand-r16*  *LPP* |   Since UE-based positioning Case 1 is a UE feature independent of other positioning method, it should also be independent of PRS capability designed for other Rel-16 related positioning methods. This means that a UE supporting UE-based positioning Case 1 does not need to support other Rel-16 related positioning methods, i.e., FG 13-1, as the prerequisite.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-1 | UE-based positioning Case 1 ~~[for inference]~~ | Indicates support of UE-based positioning Case 1 ~~[for inference]~~ | ~~FFS~~ N/A | N/A | N/A | UE-based positioning Case 1 ~~[for inference]~~ is not supported | Need for location server to know if the feature is supported. | Optional with capability signalling | |
| Vivo [6] |  |
| Xiaomi [7] |  |
| ZTE Corporation/Sanechips [8] |  |
| Samsung [9] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-1 | UE-based positioning Case 1 ~~[for inference]~~ | Indicates support of UE-based positioning Case 1 ~~[for inference]~~ | FFS | N/A | N/A | UE-based positioning Case 1 ~~[for inference]~~ is not supported | FFS | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signalling | |
| Ofinno [10] |  |
| OPPO [11] |  |
| LG Electronics [12] |  |
| Apple [13] |  |
| CMCC [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] | FG 58-2-1 was captured as a basic capability for AI/ML based positioning of case 1 in RAN1#120bis meeting. Our views are shown below.   * FG name   + In our view, if FG 58-2-1 can also be considered as a basic capability of UE-based positioning Case 1, inference operation is an essential LCM procedure for UE-based positioning Case 1. In terms of that, “for inference” can be added and the bracket can be removed for a clarification for further discussion. However, some companies think other LCM procedures (e.g., model monitoring) are highly related to model inference, and a common FG should be considered. If this FG includes other LCM procedures, [for inference] is not necessary. * Prerequisite feature groups   + FG 13-3 series, which can be considered as basic capabilities for legacy DL-TDOA of L1 UE features, have FG 13-1 as prerequisite feature groups. If FG 58-2-1 can also be considered as a basic capability of UE-based positioning Case 1, FG 13-1 can be considered as prerequisite feature groups. * Type   + The support of Case 1 positioning is not related to band/band combinations in our understanding. Therefore, the capability of reporting per UE is sufficient.  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58-2-1 | UE-based positioning Case 1 ~~[~~for inference~~]~~ | Indicates support of UE-based positioning Case 1 ~~[~~for inference~~]~~ | 13-1 | N/A | N/A | UE-based positioning Case 1 ~~[~~for inference~~]~~ is not supported | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signalling | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. NR\_AIML\_Air | 58-2-2 | Support reception of AD for UE-based positioning Case 1 | Indicates support of reception of AD for UE-based positioning Case 1 | FFS | N/A | N/A | Reception of AD for UE-based positioning Case 1 is not supported | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported.  Note: For specific ADs, UE indicate supported AD that can be received as in [FFS: FGs] | Optional with capability signalling |

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| Company | Summary |
| Ericsson [2] | For case 1, support of the assistance data is only preconditioned on the support of case 1, currently set as FG 58-2-1. If FG 58-2-1 is moved to L2, there is no need for setting a prerequisite FG. Otherwise (i.e., FG 58-2-1 is not moved to L2), the prerequisite of FG 58-2-2 should be 58-2-1.   1. FG 58-2-2 prerequisite is either 58-2-1, or “N/A” if FG 58-2-1 is moved to L2.   Additionally, RAN1 has not agreed to specific capability signalling for AD components. Thus the note on supported AD components should be removed, unless specific Rel-17/18 features such as BW aggregation are also included in case1.   1. Remove the following note from FG 58-2-2:    1. “Note: For specific ADs, UE indicate supported AD that can be received as in [FFS: FGs]” |
| Nokia [3] |  |
| CATT/CICTCI [4] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-2 | Support reception of AD for UE-based positioning Case 1 | Indicates support of reception of AD for UE-based positioning Case 1 | ~~FFS~~ 58-2-1 | N/A | N/A | Reception of AD for UE-based positioning Case 1 is not supported | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported.  Note: For specific ADs, UE indicate supported AD that can be received as in [FFS: FGs] | Optional with capability signalling | |
| Huawei/HiSilicon [5] | **Prerequisite**  Regarding the prerequisite, the UE needs to support the reception of DL-PRS resources and be able to process DL-PRS. But the common DL PRS Processing Capability in FG 13-1 has the Field name and Parent IE in TS 38.331 as listed in the below table:   |  |  | | --- | --- | | Field name in TS 38.331 | Parent IE in TS 38.331 | | *1 supportedBandwidthPRS-r16*  *2 dl-PRS-BufferType-r16*  *3 durationOfPRS-Processing-r16*  *4 maxNumOfDL-PRS-ResProcessedPerSlot-r16* | *PRS-ProcessingCapabilityPerBand-r16*  *LPP* |   Since UE-based positioning Case 1 is a UE feature independent of other positioning method, it should also be independent of PRS capability designed for other Rel-16 related positioning methods. This means that a UE supporting UE-based positioning Case 1 does not need to support other Rel-16 related positioning methods, i.e., FG 13-1, as the prerequisite.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-2 | Support reception of AD for UE-based positioning Case 1 | Indicates support of reception of AD for UE-based positioning Case 1 | ~~FFS~~ N/A | N/A | N/A | Reception of AD for UE-based positioning Case 1 is not supported | Need for location server to know if the feature is supported.  Note: For specific ADs, UE indicate supported AD that can be received as in [FFS: FGs] | Optional with capability signalling | |
| Vivo [6] |  |
| Xiaomi [7] |  |
| ZTE Corporation/Sanechips [8] |  |
| Samsung [9] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-2 | Support reception of AD for UE-based positioning Case 1 | Indicates support of reception of AD for UE-based positioning Case 1 | ~~FFS~~58-2-1 | N/A | N/A | Reception of AD for UE-based positioning Case 1 is not supported | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signalling | |
| Ofinno [10] |  |
| OPPO [11] |  |
| LG Electronics [12] |  |
| Apple [13] |  |
| CMCC [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] | Regarding the support reception of AD for UE-based positioning Case 1, for prerequisite feature groups, we think any UE feature groups are not necessary as prerequisite feature groups. It is because UE may receive assistance data for some LCM procedures such as model inference or data collection. The use case of reception of assistance data should not be limited by prerequisite feature groups. Moreover, we think the structure of existing FGs can be followed by FGs for UE-based positioning Case 1. Considering that the existing FG regarding reception of assistance data (e.g., FG 27-12) does not have any prerequisite feature groups, there is no need to introduce any UE feature groups as prerequisite feature groups.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58-2-2 | Support reception of AD for UE-based positioning Case 1 | Indicates support of reception of AD for UE-based positioning Case 1 | ~~FFS~~ | N/A | N/A | Reception of AD for UE-based positioning Case 1 is not supported | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signalling | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. NR\_AIML\_Air | 58-2-3 | DL PRS Resources for UE-based positioning Case 1 | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE  2. Max number of TRPs across all positioning frequency layers per UE  3. Max number of positioning frequency layers UE supports | [13-1] | N/A | N/A |  | Per UE | No | No | No | Component 1 candidate values: {1, 2}  Component 2 candidate values: {4, 6, 12, 16, 24, 32, 64, 128, 256}  Component 3 candidate values: {1, 2, 3, 4}  Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Company | Summary |
| Ericsson [2] | The processing FGs for DL PRS resources in case 1 were agreed in RAN1#121 to be either the legacy capability or a case 1 specific capability (58-2-4). Thus both FGs should be candidates for prerequisites for 58-2-3x FGs. As a processing capability, there is no need for pre-requisites for 58-2-4 (same as for 13-1).   1. Prerequisites for FG 58-2-3/3a/3b are either 13-1 or 58-2-4. |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-3 | DL PRS Resources for UE-based positioning Case 1 | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE  2. Max number of TRPs across all positioning frequency layers per UE  3. Max number of positioning frequency layers UE supports | 13-1 | N/A | N/A |  | Per UE | No | No | No | Component 1 candidate values: {1, 2}  Component 2 candidate values: {4, 6, 12, 16, 24, 32, 64, 128, 256}  Component 3 candidate values: {1, 2, 3, 4}  Need for location server to know if the feature is supported. | Optional with capability signaling | |
| CATT/CICTCI [4] |  |
| Huawei/HiSilicon [5] | **Prerequisite**  Regarding the prerequisite, the UE needs to support the reception of DL-PRS resources and be able to process DL-PRS. But the common DL PRS Processing Capability in FG 13-1 has the Field name and Parent IE in TS 38.331 as listed in the below table:   |  |  | | --- | --- | | Field name in TS 38.331 | Parent IE in TS 38.331 | | *1 supportedBandwidthPRS-r16*  *2 dl-PRS-BufferType-r16*  *3 durationOfPRS-Processing-r16*  *4 maxNumOfDL-PRS-ResProcessedPerSlot-r16* | *PRS-ProcessingCapabilityPerBand-r16*  *LPP* |   Since UE-based positioning Case 1 is a UE feature independent of other positioning method, it should also be independent of PRS capability designed for other Rel-16 related positioning methods. This means that a UE supporting UE-based positioning Case 1 does not need to support other Rel-16 related positioning methods, i.e., FG 13-1, as the prerequisite.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-3 | DL PRS Resources for UE-based positioning Case 1 | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE  2. Max number of TRPs across all positioning frequency layers per UE  3. Max number of positioning frequency layers UE supports | ~~[13-1]~~ N/A | N/A | N/A |  | Component 1 candidate values: {1, 2}  Component 2 candidate values: {4, 6, 12, 16, 24, 32, 64, 128, 256}  Component 3 candidate values: {1, 2, 3, 4}  Need for location server to know if the feature is supported. | Optional with capability signaling | |
| Vivo [6] |  |
| Xiaomi [7] |  |
| ZTE Corporation/Sanechips [8] |  |
| Samsung [9] |  |
| Ofinno [10] |  |
| OPPO [11] |  |
| LG Electronics [12] |  |
| Apple [13] | **Proposal 4-1: Update FG 58-2-3 (DL PRS Resources for UE-based positioning Case 1)**   * **Prerequisite feature groups: 58-2-z1; otherwise 13-1** |
| CMCC [14] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-3 | DL PRS Resources for UE-based positioning Case 1 | ~~[~~1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE.  ~~Values = {1, 2}~~  2. Max number of TRPs across all positioning frequency layers per UE.  ~~Values = {4, 6, 12, 16, 24, 32, 64, 128, 256}~~  3. Max number of positioning frequency layers UE supports  ~~Values = {1, 2, 3, 4}]~~ | 13-1 | N/A | N/A |  | ~~FFS~~ Per UE | ~~FFS~~ n/a | ~~FFS~~ n/a | ~~FFS~~ n/a | Component 1 candidate values: {1, 2}  Component 2 candidate values: {4, 6, 12, 16, 24, 32, 64, 128, 256}  Component 3 candidate values: {1, 2, 3, 4}  Need for location server to know if the feature is supported. | Optional with capability signaling | |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] | In Rel-19 discussion, there is no agreement to enhance DL PRS Resources for AI/ML based positioning. Therefore, we think it is straightforward to follow the elements of existing FGs 13-2/3/4 series. We also think that the relationship between FG 58-2-4 and 58-2-3 series is similar to the relationship between FG13-1 and FG 13-3 series of a basic capabilities for legacy DL-TDOA of L1 UE features. Based on them, prerequisite feature group is FG 58-2-4 or FG 13-1.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58-2-3 | DL PRS Resources for UE-based positioning Case 1 | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE  2. Max number of TRPs across all positioning frequency layers per UE  3. Max number of positioning frequency layers UE supports | 58-2-4; otherwise  13-1 | N/A | N/A |  | Per UE | n/a | n/a | n/a | Component 1 candidate values: {1, 2}  Component 2 candidate values: {4, 6, 12, 16, 24, 32, 64, 128, 256}  Component 3 candidate values: {1, 2, 3, 4}  Need for location server to know if the feature is supported. | Optional with capability signaling | |

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| 58. NR\_AIML\_Air | 58-2-3a | DL PRS Resources for UE-based positioning Case 1 on a band | [1. Max number of DL PRS Resources per DL PRS Resource Set  2. Max number of DL PRS Resources per positioning frequency layer | [13-1] | N/A | N/A |  | Per band | n/a | n/a | n/a | Component 1 candidate values: {1, 2, 4, 8, 16, 32, 64}  Component 2 candidate values: {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: For component 1, the values 16, 32, 64 are only applicable to FR2 bands  Note: For component 2, the value 6 is only applicable to FR1 bands  Need for location server to know if the feature is supported.  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |

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| Company | Summary |
| Ericsson [2] | The processing FGs for DL PRS resources in case 1 were agreed in RAN1#121 to be either the legacy capability or a case 1 specific capability (58-2-4). Thus both FGs should be candidates for prerequisites for 58-2-3x FGs. As a processing capability, there is no need for pre-requisites for 58-2-4 (same as for 13-1).   1. Prerequisites for FG 58-2-3/3a/3b are either 13-1 or 58-2-4. |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-3a | DL PRS Resources for UE-based positioning Case 1 on a band | [1. Max number of DL PRS Resources per DL PRS Resource Set  2. Max number of DL PRS Resources per positioning frequency layer | 13-1 | N/A | N/A |  | Per band | n/a | n/a | n/a | Component 1 candidate values: {1, 2, 4, 8, 16, 32, 64}  Component 2 candidate values: {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: For component 1, the values 16, 32, 64 are only applicable to FR2 bands  Note: For component 2, the value 6 is only applicable to FR1 bands  Need for location server to know if the feature is supported.  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling | |
| CATT/CICTCI [4] |  |
| Huawei/HiSilicon [5] | **Prerequisite**  Regarding the prerequisite, the UE needs to support the reception of DL-PRS resources and be able to process DL-PRS. But the common DL PRS Processing Capability in FG 13-1 has the Field name and Parent IE in TS 38.331 as listed in the below table:   |  |  | | --- | --- | | Field name in TS 38.331 | Parent IE in TS 38.331 | | *1 supportedBandwidthPRS-r16*  *2 dl-PRS-BufferType-r16*  *3 durationOfPRS-Processing-r16*  *4 maxNumOfDL-PRS-ResProcessedPerSlot-r16* | *PRS-ProcessingCapabilityPerBand-r16*  *LPP* |   Since UE-based positioning Case 1 is a UE feature independent of other positioning method, it should also be independent of PRS capability designed for other Rel-16 related positioning methods. This means that a UE supporting UE-based positioning Case 1 does not need to support other Rel-16 related positioning methods, i.e., FG 13-1, as the prerequisite.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-3a | DL PRS Resources for UE-based positioning Case 1 on a band | [1. Max number of DL PRS Resources per DL PRS Resource Set  2. Max number of DL PRS Resources per positioning frequency layer | ~~[13-1]~~ N/A | N/A | N/A |  | Component 1 candidate values: {1, 2, 4, 8, 16, 32, 64}  Component 2 candidate values: {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: For component 1, the values 16, 32, 64 are only applicable to FR2 bands  Note: For component 2, the value 6 is only applicable to FR1 bands  Need for location server to know if the feature is supported.  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling | |
| Vivo [6] |  |
| Xiaomi [7] |  |
| ZTE Corporation/Sanechips [8] |  |
| Samsung [9] |  |
| Ofinno [10] |  |
| OPPO [11] |  |
| LG Electronics [12] |  |
| Apple [13] | **Proposal 4-2: Update FG 58-2-3a (DL PRS Resources for UE-based positioning Case 1 on a band)**   * **Prerequisite feature groups: 58-2-z1; otherwise 13-1** |
| CMCC [14] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-3a | DL PRS Resources for UE-based positioning Case 1 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~~  2. 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 | N/A | N/A |  | ~~FFS~~ Per band | ~~FFS~~ n/a | ~~FFS~~ n/a | ~~FFS~~ n/a | Component 1 candidate values: {1, 2, 4, 8, 16, 32, 64}  Component 2 candidate values: {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: For component 1, the values 16, 32, 64 are only applicable to FR2 bands  Note: For component 2, the value 6 is only applicable to FR1 bands  Need for location server to know if the feature is supported.  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling | |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] | In Rel-19 discussion, there is no agreement to enhance DL PRS Resources for AI/ML based positioning. Therefore, we think it is straightforward to follow the elements of existing FGs 13-2/3/4 series. We also think that the relationship between FG 58-2-4 and 58-2-3 series is similar to the relationship between FG13-1 and FG 13-3 series of a basic capabilities for legacy DL-TDOA of L1 UE features. Based on them, prerequisite feature group is FG 58-2-4 or FG 13-1.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58-2-3a | DL PRS Resources for UE-based positioning Case 1 on a band | 1. Max number of DL PRS Resources per DL PRS Resource Set  2. Max number of DL PRS Resources per positioning frequency layer | 58-2-4; otherwise  13-1 | N/A | N/A |  | Per Band | n/a | n/a | n/a | Component 1 candidate values: {1, 2, 4, 8, 16, 32, 64}  Component 2 candidate values: {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: For component 1, the values 16, 32, 64 are only applicable to FR2 bands  Note: For component 2, the value 6 is only applicable to FR1 bands  Need for location server to know if the feature is supported.  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling | |

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| 58. NR\_AIML\_Air | 58-2-3b | DL PRS Resources for UE-based positioning Case 1 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  2. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only  3. 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  4. 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 | [13-1] | N/A | N/A |  | Per BC | n/a | n/a | n/a | Component 1 candidate values: {6, 24, 64, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR1 only BC  Component 2 candidate values: {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC  Component 3 candidate values: {6, 24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands  Component 4 candidate values: {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands]  Need for location server to know if the feature is supported.  Note: the reported value is the total number across all bands in the corresponding BC  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |

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| Company | Summary |
| Ericsson [2] | The processing FGs for DL PRS resources in case 1 were agreed in RAN1#121 to be either the legacy capability or a case 1 specific capability (58-2-4). Thus both FGs should be candidates for prerequisites for 58-2-3x FGs. As a processing capability, there is no need for pre-requisites for 58-2-4 (same as for 13-1).   1. Prerequisites for FG 58-2-3/3a/3b are either 13-1 or 58-2-4. |
| Nokia [3] |  |
| CATT/CICTCI [4] |  |
| Huawei/HiSilicon [5] | **Prerequisite**  Regarding the prerequisite, the UE needs to support the reception of DL-PRS resources and be able to process DL-PRS. But the common DL PRS Processing Capability in FG 13-1 has the Field name and Parent IE in TS 38.331 as listed in the below table:   |  |  | | --- | --- | | Field name in TS 38.331 | Parent IE in TS 38.331 | | *1 supportedBandwidthPRS-r16*  *2 dl-PRS-BufferType-r16*  *3 durationOfPRS-Processing-r16*  *4 maxNumOfDL-PRS-ResProcessedPerSlot-r16* | *PRS-ProcessingCapabilityPerBand-r16*  *LPP* |   Since UE-based positioning Case 1 is a UE feature independent of other positioning method, it should also be independent of PRS capability designed for other Rel-16 related positioning methods. This means that a UE supporting UE-based positioning Case 1 does not need to support other Rel-16 related positioning methods, i.e., FG 13-1, as the prerequisite.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-3b | DL PRS Resources for UE-based positioning Case 1 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  2. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only  3. 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  4. 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 | ~~[13-1]~~ N/A | N/A | N/A |  | Component 1 candidate values: {6, 24, 64, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR1 only BC  Component 2 candidate values: {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC  Component 3 candidate values: {6, 24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands  Component 4 candidate values: {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands]  Need for location server to know if the feature is supported.  Note: the reported value is the total number across all bands in the corresponding BC  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling | |
| Vivo [6] |  |
| Xiaomi [7] |  |
| ZTE Corporation/Sanechips [8] |  |
| Samsung [9] |  |
| Ofinno [10] |  |
| OPPO [11] |  |
| LG Electronics [12] |  |
| Apple [13] | **Proposal 4-3: Update FG 58-2-3b (DL PRS Resources for UE-based positioning Case 1 on a band combination)**   * **Prerequisite feature groups: 58-2-z1; otherwise 13-1** |
| CMCC [14] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-3b | DL PRS Resources for UE-based positioning Case 1 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.~~  2. 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~~  3. 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, 96, 128, 192, 256, 512, 1024, 2048}~~  ~~Note this is reported for BC containing FR1 and FR2 bands~~  4. 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 | N/A | N/A |  | ~~FFS~~ Per BC | ~~FFS~~ n/a | ~~FFS~~ n/a | ~~FFS~~ n/a | Component 1 candidate values: {6, 24, 64, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR1 only BC  Component 2 candidate values: {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC  Component 3 candidate values: {6, 24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands  Component 4 candidate values: {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands]  Need for location server to know if the feature is supported.  Note: ~~[~~the reported value is the total number across all bands in the corresponding BC~~]~~  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling | |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] | In Rel-19 discussion, there is no agreement to enhance DL PRS Resources for AI/ML based positioning. Therefore, we think it is straightforward to follow the elements of existing FGs 13-2/3/4 series. We also think that the relationship between FG 58-2-4 and 58-2-3 series is similar to the relationship between FG13-1 and FG 13-3 series of a basic capabilities for legacy DL-TDOA of L1 UE features. Based on them, prerequisite feature group is FG 58-2-4 or FG 13-1.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58-2-3b | DL PRS Resources for UE-based positioning Case 1 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  2. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only  3. 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  4. 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 | 58-2-4; otherwise  13-1 | N/A | N/A |  | Per BC | n/a | n/a | n/a | Component 1 candidate values: {6, 24, 64, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR1 only BC  Component 2 candidate values: {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC  Component 3 candidate values: {6, 24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands  Component 4 candidate values: {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands]  Need for location server to know if the feature is supported.  Note: the reported value is the total number across all bands in the corresponding BC  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling | |

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| 58. NR\_AIML\_Air | 58-2-4 | DL PRS Processing Capability for UE-based positioning Case 1 | 1. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE.  2. DL PRS buffering capability: Type 1 or Type 2  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering  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, which is supported and reported by UE.  4. Max number of DL PRS resources that UE can process in a slot under it  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%. | FFS | No | N/A |  | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  Component 1 candidate values:  -FR1 bands values {5, 10, 20, 40, 50, 80, 100}  -FR2 bands values {50, 100, 200, 400}  Component 3 candidate values:  -T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  -N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Component 4 candidate values:  -FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  -FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  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  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support PRS processing in this band or band combination.  [Note: If the UE reports both FG 13-1 and [this FG], then the UE is not expected to perform simultaneous processing of legacy methods and Case 1 positioning method.  Note: If UE does not provide [this FG] but the UE supports Case 1, FG 13-1 indicates the DL PRS processing capabilities common across all positioning methods including UE-based positioning Case 1.] | Optional with capability signaling |

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| Company | Summary |
| Ericsson [2] | The processing FGs for DL PRS resources in case 1 were agreed in RAN1#121 to be either the legacy capability or a case 1 specific capability (58-2-4). Thus both FGs should be candidates for prerequisites for 58-2-3x FGs. As a processing capability, there is no need for pre-requisites for 58-2-4 (same as for 13-1).   1. Prerequisite of FG 58-2-4 is “N/A”, i.e., no pre-requisites for FG 58-2-4. 2. Confirm the notes for FG 58-2-4. |
| Nokia [3] |  |
| CATT/CICTCI [4] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-4 | DL PRS Processing Capability for UE-based positioning Case 1 | 1. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE.  2. DL PRS buffering capability: Type 1 or Type 2  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering  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, which is supported and reported by UE.  4. Max number of DL PRS resources that UE can process in a slot under it  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%. | ~~FFS~~  58-2-1 | No | N/A |  | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  Component 1 candidate values:  -FR1 bands values {5, 10, 20, 40, 50, 80, 100}  -FR2 bands values {50, 100, 200, 400}  Component 3 candidate values:  -T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  -N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Component 4 candidate values:  -FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  -FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  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  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support PRS processing in this band or band combination.  [Note: If the UE reports both FG 13-1 and [this FG], then the UE is not expected to perform simultaneous processing of legacy methods and Case 1 positioning method.  Note: If UE does not provide [this FG] but the UE supports Case 1, FG 13-1 indicates the DL PRS processing capabilities common across all positioning methods including UE-based positioning Case 1.] | Optional with capability signaling | |
| Huawei/HiSilicon [5] | **Prerequisite**  Regarding the prerequisite, the UE needs to support the reception of DL-PRS resources and be able to process DL-PRS. But the common DL PRS Processing Capability in FG 13-1 has the Field name and Parent IE in TS 38.331 as listed in the below table:   |  |  | | --- | --- | | Field name in TS 38.331 | Parent IE in TS 38.331 | | *1 supportedBandwidthPRS-r16*  *2 dl-PRS-BufferType-r16*  *3 durationOfPRS-Processing-r16*  *4 maxNumOfDL-PRS-ResProcessedPerSlot-r16* | *PRS-ProcessingCapabilityPerBand-r16*  *LPP* |   Since UE-based positioning Case 1 is a UE feature independent of other positioning method, it should also be independent of PRS capability designed for other Rel-16 related positioning methods. This means that a UE supporting UE-based positioning Case 1 does not need to support other Rel-16 related positioning methods, i.e., FG 13-1, as the prerequisite.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-4 | DL PRS Processing Capability for UE-based positioning Case 1 | 1. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE.  2. DL PRS buffering capability: Type 1 or Type 2  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering  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, which is supported and reported by UE.  4. Max number of DL PRS resources that UE can process in a slot under it  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%. | ~~FFS~~ N/A | N/A | N/A |  | Need for location server to know if the feature is supported.  Component 1 candidate values:  -FR1 bands values {5, 10, 20, 40, 50, 80, 100}  -FR2 bands values {50, 100, 200, 400}  Component 3 candidate values:  -T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  -N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Component 4 candidate values:  -FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  -FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  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  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support PRS processing in this band or band combination.  [Note: If the UE reports both FG 13-1 and [this FG], then the UE is not expected to perform simultaneous processing of legacy methods and Case 1 positioning method.  Note: If UE does not provide [this FG] but the UE supports Case 1, FG 13-1 indicates the DL PRS processing capabilities common across all positioning methods including UE-based positioning Case 1.] | Optional with capability signaling | |
| Vivo [6] |  |
| Xiaomi [7] |  |
| ZTE Corporation/Sanechips [8] |  |
| Samsung [9] |  |
| Ofinno [10] |  |
| OPPO [11] |  |
| LG Electronics [12] |  |
| Apple [13] | **Proposal 4-4: Update FG 58-2-z1 (DL PRS Processing Capability for UE-based positioning Case 1)**   * **Prerequisite feature groups: None** * **Remove bracket from note:**   + **Note: If the UE reports both FG 13-1 and [this FG], then the UE is not expected to perform simultaneous processing of legacy methods and Case 1 positioning method.**   + **Note: If UE does not provide FG 58-x-y but the UE supports Case 1, FG 13-x indicates the capabilities common across all positioning methods including UE-based positioning Case 1.** |
| CMCC [14] | |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-z1 | DL PRS Processing Capability for UE-based positioning Case 1 | 1. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE.  2. DL PRS buffering capability: Type 1 or Type 2  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering  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, which is supported and reported by UE.  4. Max number of DL PRS resources that UE can process in a slot under it  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%. | FFS | No | N/A | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  Component 1 candidate values:  -FR1 bands values {5, 10, 20, 40, 50, 80, 100}  -FR2 bands values {50, 100, 200, 400}  Component 3 candidate values:  -T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  -N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Component 4 candidate values:  -FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  -FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  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  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support PRS processing in this band or band combination.  Note: If the UE reports both FG 13-1 and this FG, then the UE is not expected to perform simultaneous processing of legacy methods and Case 1 positioning method.  Note: If UE does not provide this FG but the UE supports Case 1, FG 13-1 indicates the DL PRS processing capabilities common across all positioning methods including UE-based positioning Case 1. | Optional with capability signaling | |
| Qualcomm Incorporated [15] | For PRS processing, the AIML model can learn features that are bandwidth (BW) dependent and specific. Therefore, it may not support bandwidth similar to legacy methods. In addition, the features of buffering assumptions, measurement period parameters (e.g., T and N), and number of PRSs to be processed in one slot can be impacted by AIML model complexity, making them different from those assumed by legacy methods. AIML processing can have processing and load balancing different from legacy methods. The UE may need extra processing (e.g., preprocessing for measurements as model input) which is not necessarily needed for the legacy methods. Therefore, the PRS processing features of Case 1 need to be differentiated from legacy methods. RAN1 agreed to consider a dedicated FG for AIML PRS processing (i.e., FG 58-2-4). There were pending discussions about these two aspects:   * Whether UE is expected to support simultaneous operation for Case 1 and legacy methods, and if so, what would be assumed regarding the joint processing capabilities for Case 1 and other legacy methods. * If UE does not provide FG of PRS processing capability for Case 1 (i.e., FG 58-2-4), then can LMF assume the legacy PRS processing of legacy methods (i.e., FG 13-1) apply to Case 1   Regarding the above two aspects, we find the following need to be clarified:   * For existing legacy methods, it is the convention that LMF may not always assume UE can run two legacy methods simultaneously (e.g., simultaneous DL AoD and DL TdoA or simultaneous DL AoD and multi RTT) unless UE indicates such operation is possible and supported. The LMF can still configure multiple legacy methods but it is UE implementation to decide running them as hybrid or sequentially. We find the same principle need to be introduced for Case 1 and other existing methods. LMF need not assume simultaneous Case 1 and other existing methods unless a separate FG is indicated to show such support. We propose to introduce a new FG to show if UE can support Case 1 and other methods simultaneously. The LMF can still configure multiple positioning (legacy and AIML) methods, but it would be for UE implementation on whether to run them simultaneously/hybrid or sequentially. * For Case 1 PRS processing capabilities, the UE may support some common values of those corresponding to existing legacy methods. From signaling perspective, to optimize signaling overhead, it is beneficial to let UE skip repeating common PRS processing values to those indicated for existing legacy methods (i.e. those indicated in FG 13-1). We propose keeping the second note with enhanced wording to describe the above intention:   + Note: if UE supports same PRS processing capability values for one or more components as in FG 13-1, then the UE can skip indicating these components in this FG and the values in corresponding FG 13-1 components indicate supported PRS processing capabilities for Case 1   **Proposal 1: Modify the Rel. 19 UE FG of PRS processing capabilities for UE-based positioning Case 1:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-4 | DL PRS Processing Capability for UE-based positioning Case 1 | 1. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE.  2. DL PRS buffering capability: Type 1 or Type 2  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering  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, which is supported and reported by UE.  4. Max number of DL PRS resources that UE can process in a slot under it  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%. | ~~FFS~~  58-2-1 | No | N/A |  | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  Component 1 candidate values:  -FR1 bands values {5, 10, 20, 40, 50, 80, 100}  -FR2 bands values {50, 100, 200, 400}  Component 3 candidate values:  -T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  -N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Component 4 candidate values:  -FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  -FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  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  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support PRS processing in this band or band combination.  ~~[Note: If the UE reports both FG 13-1 and [this FG], then the UE is not expected to perform simultaneous processing of legacy methods and Case 1 positioning method.~~  ~~Note: If UE does not provide [this FG] but the UE supports Case 1, FG 13-1 indicates the DL PRS processing capabilities common across all positioning methods including UE-based positioning Case 1.]~~  Note: if UE supports same values for one or more components as in FG 13-1, then the UE can skip indicating these components in this FG and the values in corresponding FG 13-1 components indicate supported PRS processing capabilities for Case 1 | Optional with capability signaling | |
| NTT DOCOMO, INC. [16] | Regarding DL PRS Processing Capability for UE-based positioning Case 1, our views are shown below.   * Prerequisite group   + Since DL PRS Processing Capability for legacy positioning (FG 13-1) does not have any prerequisite feature group, it is unnecessary for FG 58-2-4 to introduce any prerequisite feature groups. Regarding FG 13-1, in our understanding, FG 58-2-4 is independent from FG 13-1. Therefore, FG 13-1 is not needed for prerequisite feature groups. * Note   + The bracketed part describes how process DL PRS when FG 13-1 is provided with/without FG 58-2-4. It is important to clarify which capability is applied to avoid collusion and these notes are align with our view. Therefore, these brackets can be removed.  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58-2-4 | DL PRS Processing Capability for UE-based positioning Case 1 | 1. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE.  2. DL PRS buffering capability: Type 1 or Type 2  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering    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, which is supported and reported by UE.    4. Max number of DL PRS resources that UE can process in a slot under it    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%. | ~~FFS~~ | No | N/A |  | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.    Component 1 candidate values:  -FR1 bands values {5, 10, 20, 40, 50, 80, 100}  -FR2 bands values {50, 100, 200, 400}    Component 3 candidate values:  -T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  -N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms    Component 4 candidate values:  -FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  -FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz      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    Note: if the UE does not indicate this capability for a band or band combination, the UE does not support PRS processing in this band or band combination.    ~~[~~Note: If the UE reports both FG 13-1 and ~~[~~this FG~~]~~, then the UE is not expected to perform simultaneous processing of legacy methods and Case 1 positioning method.    Note: If UE does not provide ~~[~~this FG~~]~~ but the UE supports Case 1, FG 13-1 indicates the DL PRS processing capabilities common across all positioning methods including UE-based positioning Case 1.~~]~~ | Optional with capability signaling | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. NR\_AIML\_Air | 58-2-5 | Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of SSB from neighbour 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 | [58-2-4; otherwise  13-1] | No | N/A | SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Summary |
| Ericsson [2] |  |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-5 | Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of SSB from neighbour 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 | 58-2-4; otherwise  13-1 | No | N/A | SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling | |
| CATT/CICTCI [4] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-5 | Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of SSB from neighbour 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 | ~~[~~58-2-4; otherwise  13-1~~]~~ | No | N/A | SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling | |
| Huawei/HiSilicon [5] | **Prerequisite**  Regarding the prerequisite, the UE needs to support the reception of DL-PRS resources and be able to process DL-PRS. But the common DL PRS Processing Capability in FG 13-1 has the Field name and Parent IE in TS 38.331 as listed in the below table:   |  |  | | --- | --- | | Field name in TS 38.331 | Parent IE in TS 38.331 | | *1 supportedBandwidthPRS-r16*  *2 dl-PRS-BufferType-r16*  *3 durationOfPRS-Processing-r16*  *4 maxNumOfDL-PRS-ResProcessedPerSlot-r16* | *PRS-ProcessingCapabilityPerBand-r16*  *LPP* |   Since UE-based positioning Case 1 is a UE feature independent of other positioning method, it should also be independent of PRS capability designed for other Rel-16 related positioning methods. This means that a UE supporting UE-based positioning Case 1 does not need to support other Rel-16 related positioning methods, i.e., FG 13-1, as the prerequisite.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-5 | Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of SSB from neighbour 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 | [58-2-4; otherwise N/A  ~~13-1~~] | N/A | N/A |  | Need for location server to know if the feature is supported. | Optional with capability signaling | |
| Vivo [6] |  |
| Xiaomi [7] |  |
| ZTE Corporation/Sanechips [8] |  |
| Samsung [9] |  |
| Ofinno [10] |  |
| OPPO [11] |  |
| LG Electronics [12] |  |
| Apple [13] | **Proposal 4-5: Update FG 58-2-x (Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1)**   * **Prerequisite feature groups: 58-2-z1; otherwise 13-1** |
| CMCC [14] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-x | Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of SSB from neighbour 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 | 58-2-z1; otherwise  13-1 | No | N/A | SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling | |
| Qualcomm Incorporated [15] | For QCL processing, the AI/ML model learns spatial features with respect to TRPs. Whether UE can support a specific source for deriving QCL relations when obtaining relevant PRS measurements depends on model development and dataset used for training. The AIML model can be sensitive to the QCL source assumption. To ensure consistency between training and inference, the UE features for QCL processing need to be separate and not necessarily common to legacy methods. RAN1 agreed to support FGs specific for QCL source related to Case 1:   * Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 * Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Agreement: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-5 | Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of SSB from neighbour 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 | [58-2-4; otherwise  13-1] | No | N/A | SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling | | 58. NR\_AIML\_Air | 58-2-6 | Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS  Note 1: Refers to Type-D support for FR2  Note 2: A PRS from a PRS-only TP is treated as PRS from a non-serving cell | [58-2-4; otherwise  13-1] | No | N/A | DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  DL PRSs are in the same band | Optional with capability signaling | |   UE may support QCL source and relations same to existing legacy methods. If this is the case, to optimize the signaling overhead, the UE may skip those components or FGs that are common to existing legacy methods. We propose adding the following notes:   * Note: if UE supports same values for one or more components as in FG 13-7, then the UE can skip indicating these components in this FG and the values in corresponding FG 13-7 components indicate supported QCL sources for Case 1 * Note: if UE supports same values for one or more components as in FG 13-7a, then the UE can skip indicating these components in this FG and the values in corresponding FG 13-7a components indicate supported QCL sources for Case 1   **Proposal 3: Modify the Rel. 19 UE FG of PRS processing capabilities for UE-based positioning Case 1:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-5 | Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of SSB from neighbour 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 | ~~[~~58-2-4; ~~otherwise~~  ~~13-1]~~ | No | N/A | SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  Note: if UE supports same values for one or more components as in FG 13-7, then the UE can skip indicating these components in this FG and the values in corresponding FG 13-7 components indicate supported QCL sources for Case 1 | Optional with capability signaling | |
| NTT DOCOMO, INC. [16] | For Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1, following the legacy capability “Support of SSB from neighbour cell as QCL source of a DL PRS,” prerequisite feature groups should be DL PRS Processing Capability. Following this principle, prerequisite feature group is FG 58-2-4 or FG 13-1. Therefore, we are fine to remove the bracket.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58-2-5 | Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of SSB from neighbour 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 | ~~[~~58-2-4; otherwise  13-1~~]~~ | No | N/A | SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. NR\_AIML\_Air | 58-2-6 | Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS  Note 1: Refers to Type-D support for FR2  Note 2: A PRS from a PRS-only TP is treated as PRS from a non-serving cell | [58-2-4; otherwise  13-1] | No | N/A | DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  DL PRSs are in the same band | Optional with capability signaling |

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| --- | --- |
| Company | Summary |
| Ericsson [2] |  |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-6 | Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS  Note 1: Refers to Type-D support for FR2  Note 2: A PRS from a PRS-only TP is treated as PRS from a non-serving cell | 58-2-4; otherwise  13-1 | No | N/A | DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  DL PRSs are in the same band | Optional with capability signaling | |
| CATT/CICTCI [4] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-6 | Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS  Note 1: Refers to Type-D support for FR2  Note 2: A PRS from a PRS-only TP is treated as PRS from a non-serving cell | ~~[~~58-2-4; otherwise  13-1~~]~~ | No | N/A | DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  DL PRSs are in the same band | Optional with capability signaling | |
| Huawei/HiSilicon [5] | **Prerequisite**  Regarding the prerequisite, the UE needs to support the reception of DL-PRS resources and be able to process DL-PRS. But the common DL PRS Processing Capability in FG 13-1 has the Field name and Parent IE in TS 38.331 as listed in the below table:   |  |  | | --- | --- | | Field name in TS 38.331 | Parent IE in TS 38.331 | | *1 supportedBandwidthPRS-r16*  *2 dl-PRS-BufferType-r16*  *3 durationOfPRS-Processing-r16*  *4 maxNumOfDL-PRS-ResProcessedPerSlot-r16* | *PRS-ProcessingCapabilityPerBand-r16*  *LPP* |   Since UE-based positioning Case 1 is a UE feature independent of other positioning method, it should also be independent of PRS capability designed for other Rel-16 related positioning methods. This means that a UE supporting UE-based positioning Case 1 does not need to support other Rel-16 related positioning methods, i.e., FG 13-1, as the prerequisite.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-6 | Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS  Note 1: Refers to Type-D support for FR2  Note 2: A PRS from a PRS-only TP is treated as PRS from a non-serving cell | [58-2-4; otherwise N/A  ~~13-1~~] | N/A | N/A |  | Need for location server to know if the feature is supported.  DL PRSs are in the same band | Optional with capability signaling | |
| Vivo [6] |  |
| Xiaomi [7] |  |
| ZTE Corporation/Sanechips [8] |  |
| Samsung [9] |  |
| Ofinno [10] |  |
| OPPO [11] |  |
| LG Electronics [12] |  |
| Apple [13] | **Proposal 4-6: Update FG 58-2-x (Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1)**   * **Prerequisite feature groups: 58-2-z1; otherwise 13-1** |
| CMCC [14] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-x | Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS  Note 1: Refers to Type-D support for FR2  Note 2: A PRS from a PRS-only TP is treated as PRS from a non-serving cell | 58-2-z1; otherwise  13-1 | No | N/A | DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  DL PRSs are in the same band | Optional with capability signaling | |
| Qualcomm Incorporated [15] | For QCL processing, the AI/ML model learns spatial features with respect to TRPs. Whether UE can support a specific source for deriving QCL relations when obtaining relevant PRS measurements depends on model development and dataset used for training. The AIML model can be sensitive to the QCL source assumption. To ensure consistency between training and inference, the UE features for QCL processing need to be separate and not necessarily common to legacy methods. RAN1 agreed to support FGs specific for QCL source related to Case 1:   * Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 * Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Agreement: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-5 | Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of SSB from neighbour 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 | [58-2-4; otherwise  13-1] | No | N/A | SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling | | 58. NR\_AIML\_Air | 58-2-6 | Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS  Note 1: Refers to Type-D support for FR2  Note 2: A PRS from a PRS-only TP is treated as PRS from a non-serving cell | [58-2-4; otherwise  13-1] | No | N/A | DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  DL PRSs are in the same band | Optional with capability signaling | |   UE may support QCL source and relations same to existing legacy methods. If this is the case, to optimize the signaling overhead, the UE may skip those components or FGs that are common to existing legacy methods. We propose adding the following notes:   * Note: if UE supports same values for one or more components as in FG 13-7, then the UE can skip indicating these components in this FG and the values in corresponding FG 13-7 components indicate supported QCL sources for Case 1 * Note: if UE supports same values for one or more components as in FG 13-7a, then the UE can skip indicating these components in this FG and the values in corresponding FG 13-7a components indicate supported QCL sources for Case 1   **Proposal 3: Modify the Rel. 19 UE FG of PRS processing capabilities for UE-based positioning Case 1:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-6 | Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS  Note 1: Refers to Type-D support for FR2  Note 2: A PRS from a PRS-only TP is treated as PRS from a non-serving cell | ~~[~~58-2-4; ~~otherwise~~  ~~13-1~~] | No | N/A | DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  DL PRSs are in the same band  Note: if UE supports same values for one or more components as in FG 13-7a, then the UE can skip indicating these components in this FG and the values in corresponding FG 13-7a components indicate supported QCL sources for Case 1 | Optional with capability signaling | |
| NTT DOCOMO, INC. [16] | Same as FG 58-2-5, FG 58-2-6 follows the legacy capability “Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS,” i.e., the bracket in prerequisite feature groups can be removed.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58-2-6 | Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS  Note 1: Refers to Type-D support for FR2  Note 2: A PRS from a PRS-only TP is treated as PRS from a non-serving cell | ~~[~~58-2-4; otherwise  13-1~~]~~ | No | N/A | DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported.    DL PRSs are in the same band | Optional with capability signaling | |

**Other**

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| Company | Summary |
| Ericsson [2] | During RAN1#121 there was further discussion on case 1 capability related to features supported in DL-TDOA assistance data that were introduced beyond Rel-16. Such as:   * AD for bandwidth aggregation * AD for reception in idle/inactive * Gapless measurements   Considering that the basis for case 1 is UE based positioning in existing specifications, RAN1 should at least discuss how these features should be supported. Clearly current capability signalling can be reused for the case where the legacy PRS processing capability applies. In last meeting it was also proposed to introduce further FGs for the cases where the new case 1 PRS processing capability is used. In our view, RAN1 could introduce features up to and including Rel-17, but not Rel-18, since the AIML study was made in Rel-18 and did not take into account Rel-18 positioning.   1. Support additional FGs for introduction of case 1 specific processing capability and when using up to Re-l17 features for UE based positioning. |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | [58-2-7] | Support of Associated ID for UE-based positioning Case 1 | Indicates support of Associated ID for UE-based positioning Case 1 | FFS | N/A | N/A | Reception of Associated ID for UE-based positioning Case 1 is not supported | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported.  Note: The Associated ID is used to provide implicit information of Info #7 of the assistance information from legacy UE-based DL-TDOA. | Optional with capability signalling | | 58. NR\_AIML\_Air | [58-2-8] | Support performance monitoring for positioning Case 1 | Indicates support of performance monitoring for positioning Case 1 | 58-2-1 | N/A | N/A | Performance monitoring for positioning Case 1 is not supported | Per UE | n/a | n/a | n/a | Note: at least an indication that the target UE cannot perform the Case 1 positioning method.  FFS: details related signalization defined by RAN2 | Optional with capability signalling | |
| CATT/CICTCI [4] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-7 | Performance monitoring for UE-based positioning Case 1 | 1. Support of UE-side performance monitoring for UE-based positioning Case 1  2. Support of Option A-1, i.e. LMF provides ground truth label to UE  3. Support of Option A-2, i.e. LMF provides position calculation assistance to UE  4. Support of Option A-3, i.e. LMF provides PRU measurement and location to UE | 58-3-1 | N/A | N/A | UE performance monitoring for positioning is not supported | FFS | N/A | N/A | N/A |  | Optional with capability signalling | |
| Huawei/HiSilicon [5] |  |
| Vivo [6] | 1. Introduce the following Rel. 19 UE FGs for AI/ML based positioning.  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | **Consequence if the feature is not supported by the UE** | Note | | X. NR\_AIML\_Air | X-2-1 | AI/ML based positioning for UE-side model | 1. Support of AI/ML based positioning Case 1 | FFS | N/A | AI/ML based positioning Case 1 is not supported | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | | X. NR\_AIML\_Air | X-2-2 | Support of model monitoring for AI/ML based positioning for UE-side model | 1. Support of performance monitoring for AI/ML based positioning Case 1 | FFS | N/A | Performance monitoring of AI/ML based positioning Case 1 is not supported | FFS: The necessity and further partitioning of this FG depend on the future RAN1/2 agreements on the format of model monitoring outcome. | | X. NR\_AIML\_Air | X-2-3 | Support of data collection for AI/ML based positioning for UE-side model | 1. Support of Data collection for AI/ML based positioning Case 1  2. Support of Associated ID | FFS | N/A | Data collection of AI/ML based positioning Case 1 is not supported | FFS: The necessity and further partitioning of this FG depends on the future RAN1 agreements on Associated ID | |
| Xiaomi [7] |  |
| ZTE Corporation/Sanechips [8] | At the initial stage of Rel-19, 5 sub use cases are defined for AI POS enhancement, i.e.,   * Direct AI/ML positioning:   + (1st priority) Case 1: UE-based positioning with UE-side model, direct AI/ML positioning   + (2nd priority) Case 2b: UE-assisted/LMF-based positioning with LMF-side model, direct AI/ML positioning   + (1st priority) Case 3b: NG-RAN node assisted positioning with LMF-side model, direct AI/ML positioning * AI/ML assisted positioning   + (2nd priority) Case 2a: UE-assisted/LMF-based positioning with UE-side model, AI/ML assisted positioning   + (1st priority) Case 3a: NG-RAN node assisted positioning with gNB-side model, AI/ML assisted positioning   During RAN#107 meeting, it is agreed that the 2nd priority use cases won’t be pursued in Rel-19. In other words, only the following three AI POS enhancement use cases will be specified in Rel-19.   * Direct AI/ML positioning:   + (1st priority) Case 1: UE-based positioning with UE-side model, direct AI/ML positioning   + (1st priority) Case 3b: NG-RAN node assisted positioning with LMF-side model, direct AI/ML positioning * AI/ML assisted positioning   + (1st priority) Case 3a: NG-RAN node assisted positioning with gNB-side model, AI/ML assisted positioning   Among these three 1st priority use cases, case 3a is with gNB side model and case 3b is with LMF side model. The UE side operation is the same as what we have, i.e., UE only needs to transmit SRS to the base station. From this perspective, there is no need to define any new UE feature for AI POS enhancement case 3a and case 3b.  ***Proposal 7****: New UE feature for AI POS enhancement case 1 is needed, while no need to define any new UE feature for AI POS enhancement case 3a and case 3b.*  As agreed in RAN2, AI positioning case 1 is a new positioning method, where the UE features in Rel-16/17/18 can be extended to AI positioning case 1, overall, we think the following UE feature design can be considered.  ***Proposal 8****: Consider the following UE features for AI POS enhancement in Rel-19.*   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-7 | Support of PRS measurement in RRC\_INACTIVE state for case 1 | Support of PRS measurement in RRC\_INACTIVE state for case 1 - location server | 58-2-3, 27-6 | No |  | PRS measurement in RRC\_INACTIVE state for case 1 is not supported | per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  Note: PRS capabilities for case 1 described in FGs in 58-2-3, 58-2-3a, 58-2-3b are the same for RRC Inactive.  Support of PRS processing measurement in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | |
| Samsung [9] |  |
| Ofinno [10] |  |
| OPPO [11] | **Proposal 2: Support information related to UL SRS as in the capability signalling of legacy methods, detailed capability value can be further discussed if needed.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  | 58-2-6 | SRS Resources for AI Positioning Case 3a/3b | 1. Max number of SRS Resource Sets for positioning supported by UE per BWP.  Values = {1, 2, 4, 8, 12, 16}.  2. Max number of P/SP/AP SRS Resources for positioning per BWP.  Values = {1,2,4,8,16,32,64}  3. Max number of P/SP/AP SRS Resources including the SRS resources for positioning per BWP per slot.  Values = {1, 2, 3, 4, 5, 6, 8, 10, 12, 14}  Note: Max number of P/SP/AP SRS Resources in Component 3 include both SRS resources configured by SRS-Resource and SRS resources configured by SRS-PosResource-r16 supported by UE  4. Max number of periodic SRS Resources for positioning per BWP.  Values = {1,2,4,8,16,32,64}  5. Max number of periodic SRS Resources for positioning per BWP per slot.  Values = {1,2,3,4,5,6,8,10,12,14}  OLPC for SRS for positioning based on SSB from serving cell is part of FG13-8  Note: no dedicated capability signaling is intended for this component |  |  |  |  |  | n/a | n/a |  | Note: if the UE does not indicate this capability for a band in a band combination, the UE does not support SRS for Positioning in this band in the band combination. | Optional with capability signaling | |  | 58-2-7 | Support of Aperiodic SRS Resources for AI positioning Case 3a/3b | 1. Max number of aperiodic SRS Resources for positioning per BWP.  Values = {1,2,4,8,16,32,64}  2. Max number of aperiodic SRS Resources for positioning per BWP per slot.  Values = {1,2,3,4,5,6,8,10,12,14} | 58-2-6 |  |  |  |  | n/a | n/a |  |  | Optional with capability signaling | |  | 58-2-8 | Support of Semi-persistent SRS Resources for AI positioning Case 3a/3b | 1. Max number of semi-persistent SRS Resources for positioning supported by UE per BWP.  Values = {1,2,4,8,16,32,64}  2. 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} | 58-2-6 |  |  |  |  | n/a | n/a |  |  | Optional with capability signaling | |  | 58-2-9 | SRS Resources for AI Positioning Case 3a/3b | 1. Max number of SRS Resource Sets for positioning supported by UE per BWP.  Values = {1, 2, 4, 8, 12, 16}.  2. Max number of P/SP/AP SRS Resources for positioning per BWP.  Values = {1,2,4,8,16,32,64}  3. Max number of periodic SRS Resources for positioning per BWP.  Values = {1,2,4,8,16,32,64} | 58-2-6 |  |  |  |  | n/a | n/a |  | Need for location server to know if the feature is supported  UE only reports the number on bands for the current configured CA band combination | Optional with capability signaling | |  | 58-2-10 | Support of Aperiodic SRS Resources for AI positioning Case 3a/3b | 1. Max number of aperiodic SRS Resources for positioning per BWP.  Values = {1,2,4,8,16,32,64} | 58-2-7, 58-2-9 |  |  |  |  |  |  |  | Need for location server to know if the feature is supported.  UE only reports the number on bands for the current configured CA band combination. | Optional with capability signaling | |  | 58-2-11 | Support of Semi-persistent SRS Resources for AI positioning Case 3a/3b | 1. Max number of semi-persistent SRS Resources for positioning supported by UE per BWP.  Values = {1,2,4,8,16,32,64} | 58-2-6, 58-2-9 |  |  |  |  | n/a | n/a |  | Need for location server to know if the feature is supported.  UE only reports the number on bands for the current configured CA band combination | Optional with capability signaling | |
| LG Electronics [12] |  |
| Apple [13] | **Proposal 4-7:**   * **For Case 1, from the Rel-16 UE feature list for NR Positioning FG 13-1, 13-1a, 13-7, and 13-7a are applicable AI/ML-based positioning. A Case 1 specific FG should also be defined for each of these FGs.**  |  |  |  | | --- | --- | --- | | Old | New | Description | | 13-1 | 58-x-y | Common DL PRS Processing Capability for UE-based positioning Case 1 | | 13-1a | 58-x-y | Max number of positioning frequency layers UE supports across all positioning methods across all bands for UE-based positioning Case 1 | | 13-7 | 58-x-y | Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | | 13-7a | 58-x-y | Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 |   **Note: If the UE reports both FG 13-x and FG 58-x-y, then the UE is not expected to perform simultaneous processing of legacy methods and Case 1 positioning method.**  **Note: If UE does not provide FG 58-x-y but the UE supports Case 1, FG 13-x indicates the capabilities common across all positioning methods including UE-based positioning Case 1.**  **Proposal 4-8:**   * **For Case 1, From the Rel-17 UE feature list for NR Positioning FG 27-3-2, 27-3-3, 27-6, 27-10, 27-10a and 27-11 are applicable AI/ML-based positioning. A Case 1 specific FG should also be defined for each of these FGs.**  |  |  |  | | --- | --- | --- | | Old | New | Description | | 27-3-2 | 58-x-y | DL PRS measurement outside MG and in a PRS processing window | | 27-3-3 | 58-x-y | DL PRS Processing Capability outside MG - buffering capability | | 27-6 | 58-x-y | DL PRS processing capabilities in RRC inactive state | | 27-10 | 58-x-y | Support of UL MAC CE based MG activation request for PRS measurements | | 27-10a | 58-x-y | Low latency MG activation request for PRS measurements | | 27-11 | 58-x-y | Support of DL MAC CE based MG activation for PRS measurements |   **Note: If the UE reports both FG 27-x and FG FG 58-x-y, then the UE is not expected to perform simultaneous processing of legacy methods and Case 1 positioning method.**  **Note: If UE does not provide FG 58-x-y but the UE supports Case 1, FG 27-x indicates the capabilities common across all positioning methods including UE-based positioning Case 1**  **Proposal 4-9:**   * **For Case 1, From the Rel-18 UE feature list for NR Positioning, the FG for NR positioning should be made specific to UE-based positioning Case 1.** * **NOTE: No simultaneous enabling of Carrier Phase positioning and AI/ML based positioning Case 1**  |  |  |  | | --- | --- | --- | | Old | New | Description | | 41-3-3 | 58-x-y | Support of PRS measurement in RRC\_IDLE— UE-based positioning Case 1 | | 41-4-1 | 58-x-y | DL PRS processing capabilities for aggregated PRS processing of 2 PFLs in intra-band contiguous within a MG for RRC\_CONNECTED— UE-based positioning Case 1 | | 41-4-1a | 58-x-y | DL PRS processing capabilities for aggregated PRS processing of 3 PFLs in intra-band contiguous within a MG for RRC\_CONNECTED — UE-based positioning Case 1 | | 41-4-1b | 58-x-y | DL PRS processing capabilities for aggregated PRS processing of 2 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE— UE-based positioning Case 1 | | 41-4-1c | 58-x-y | DL PRS processing capabilities for aggregated PRS processing of 3 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE— UE-based positioning Case | |  | 58-x-y | PRS bandwidth aggregation in RRC\_CONNECTED — UE-based positioning Case 1 | |  | 58-x-y | PRS bandwidth aggregation in RRC\_ INACTIVE — UE-based positioning Case 1 | |  | 58-x-y | PRS bandwidth aggregation in RRC\_IDLE — UE-based positioning Case 1 |   **Note: If the UE reports both FG 41-x and FG FG 58-x-y, then the UE is not expected to perform simultaneous processing of legacy methods and Case 1 positioning method.**  **Note: If UE does not provide FG 58-x-y but the UE supports Case 1, FG 41-x indicates the capabilities common across all positioning methods including UE-based positioning Case 1** |
| CMCC [14] |  |
| Qualcomm Incorporated [15] | RAN1 agreed to consider all assistance data from existing UE-based DL-TdoA for UE-based positioning Case 1. As Case 1 is introduced as an independent method, equivalent features of DL-TdoA shall be reintroduced as new FGs for Case 1.  **Observation 1: The AI/ML positioning Case 1 is to be introduced as a new positioning method, requiring specific features related to capabilities of PRS, reporting, and receiving AD.**  **Observation 2: The AI/ML positioning Case 1 is agreed to share all ADs and PRS configurations of UE-based DL-TDoA.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Agreement (RAN1 #119: 9.1.2 AIML pos)  For AI/ML based positioning Case 1, all assistance information from legacy UE-based DL-TDOA, other than info #7, can be provided from LMF to UE. For info #7, RAN1 study, if necessary, choose one alternative from the following:   * Alternative 1. Info #7 is provided implicitly via associated ID.   + Associated ID is signalled by LMF to indicate whether info #7 is consistent between training and inference. * Alternative 2. Info #7 can be provided either implicitly or explicitly by LMF. Note: no UE capability is introduced on whether info #7 is provided implicitly or explicitly, and the UE can request info #7 to be provided explicitly or implicitly.   + If provided implicitly, associated ID is signaled by LMF to indicate whether info #7 is consistent between training and inference. * Alternative 3. Info #7 is **not** be provided from LMF to UE.   + If info #7 is not provided, UE may assume info #7 is consistent between training and inference. * Alternative 4. Info #7 is provided explicitly from LMF to UE.  |  |  | | --- | --- | | 7 | Geographical coordinates of the TRPs served by the gNB (include a transmission reference location for each DL-PRS Resource ID, reference location for the transmitting antenna of the reference TRP, relative locations for transmitting antennas of other TRPs) |  |  |  | | --- | --- | |  | **Information** | | 1 | Physical cell IDs (PCIs), global cell IDs (GCIs), ARFCN, and PRS IDs of candidate NR TRPs for measurement | | 2 | Timing relative to the serving (reference) TRP of candidate NR TRPs | | 3 | DL-PRS configuration of candidate NR TRPs | | 4 | Indication of which DL-PRS Resource Sets across DL-PRS positioning frequency layers are linked for DL-PRS bandwidth aggregation | | 5 | SSB information of the TRPs (the time/frequency occupancy of SSBs) | | 6 | Spatial direction information (e.g. azimuth, elevation etc.) of the DL-PRS Resources of the TRPs served by the gNB | | 7 | Geographical coordinates of the TRPs served by the gNB (include a transmission reference location for each DL-PRS Resource ID, reference location for the transmitting antenna of the reference TRP, relative locations for transmitting antennas of other TRPs) | | 8 | Fine Timing relative to the serving (reference) TRP of candidate NR TRPs | | 9 | PRS-only TP indication | | 10 | The association information of DL-PRS resources with TRP Tx TEG ID | | 11 | LOS/NLOS indicators | | 12 | On-Demand DL-PRS-Configurations, possibly together with information on which configurations are available for DL-PRS bandwidth aggregation | | 13 | Validity Area of the Assistance Data | | 14 | PRU measurements together with the location information of the PRU | | 15 | Data facilitating the integrity results determination of the calculated location | | 16 | TRP beam/antenna information (including azimuth angle, zenith angle and relative power between PRS resources per angle per TRP) | | 17 | Expected Angle Assistance information | | 18 | PRS priority list |   Working Assumption (RAN1#121 – AIML pos)  For AI/ML based positioning Case 1, regarding info #7 in the assistance information from legacy UE-based DL-TDOA, it can be provided as in legacy UE-based DL-TDOA or implicitly.  Agreement (RAN1#121 – AIML pos)  Above Working Assumption is confirmed.    Agreement (RAN1#121 – AIML pos)  For AI/ML based positioning Case 1, regarding Info #7 in the assistance information from legacy UE-based DL-TDOA,   * If implicitly provided, the implicit indication of Info #7 is via associated ID.   + For given TRP(s), same associated ID implies that geographical coordinates of the TRP(s) can be understood as consistent by the UE.   + The associated ID is not expected to provide the real value of Info #7 (i.e., geographical coordinates of the TRP(s) are not disclosed).   + an associated ID is configured per-cell (e.g., NCGI-r15)     - UE does not expect to receive different values of associated ID for TRPs belonging to the same NCGI-r15   + Associated ID can be realized by an identifier of N bits (e.g., 8 bits) |   From RAN1 perspective, UE features for AI/ML positioning Case 1 need to include equivalent features of UE-based DL-TdoA method, including features related to PRS resource capabilities, PRS processing capabilities, PRS QCL processing capabilities, on-demand PRS capabilities, capabilities related to reporting LocationEstimate, capabilities for receiving assistance data (AD), capabilities related to measurement gap (MG)/PRS processing window (PPW) operations, capabilities related to operation in INACTIVE/IDLE states, and capabilities related to PRS bandwidth aggregation (BWA), as follow:   * **RAN1 related features:** RS configuration related features and RAN1 ADs   + Supported PRS resource configurations   + Supported PRS QCL processing   + Supported PRS processing   + Supported PRS in INACTIVE/IDLE modes   + Supported PRS outside MG and in PPW   + Supported PRS BWA   + AD related features:     - Support for receiving AD information (e.g., agreed ADs from AD info#1 to #16 of previous agreements)   **Proposal 2: Introduce the following Rel. 19 UE FGs for UE-based positioning Case 1:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-7 | Simultaneous UE-based positioning Case 1 and DL-TDoA positioning | 1. Support of simultaneous operation for UE-based positioning Case 1 and DL TDoA  If it is not indicated, a UE is not expected to perform simultaneously the UE-based positioning Case 1 and DL TDoA positioning | 58-2-3 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 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-8 | Simultaneous UE-based positioning Case 1 and DL-AoD positioning | 1. Support of simultaneous operation for UE-based positioning Case 1 and DL AoD  If it is not indicated, a UE is not expected to perform simultaneously the UE-based Case 1 and DL AoD positioning | 58-2-3 and 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 |   For AI/ML Case 1, UE can also indicate whether it supports positioning outside MG and in PPW, similar to other positioning methods. These capabilities need to be differentiated for AI/ML as it may not be common to legacy methods. We propose the following new FGs:   * DL PRS Processing Capability outside MG - buffering capability for UE-based positioning Case 1 * DL PRS measurement outside MG and in a PRS processing window for UE-based positioning Case 1 * Support of more than one activated PRS processing windows across all active DL BWPs for UE-based positioning Case 1   In addition, if UE support component values same to common values of existing legacy methods, then UE can skip indicating those component(s). It is beneficial to indicate the UE can skip them and those indicated in other corresponding FGs become the baseline. We propose adding a note to indicate it (see newly proposed FG 58-2-10 below).  **Proposal 4: Introduce the following Rel. 19 UE FGs for UE-based positioning Case 1:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-9 | DL PRS measurement outside MG and in a PRS processing window for UE-based positioning Case 1 | 1. Supported PRS processing types subject to the UE determining that DL PRS to be higher priority for PRS measurement outside MG and in a PRS processing window  2. Support of priority handing options of PRS: Option1, Option2 or Option3  − Option 1: Support of "st1" and "st3" defined in clause 5.1.6.5 of TS 38.214 [20]  − Option 2: Support of "st1", "st2", and "st3" defined in clause 5.1.6.5 of TS 38.214 [20]  - Option 3: Support of "st1" only defined in clause 5.1.6.5 of TS 38.214 [20] | [58-2-4] | N/A | N/A | DL PRS measurement outside MG and in a PRS processing window for UE-based positioning Case 1 is not supported | Per band | FFS | FFS | FFS | Component 1 candidate values: One or more of {Type 1A, Type 1B, Type 2}  Component 2 candidate values: {option1, option2, option3}  Need for location server to know if the feature is supported  Note: Component 2 can be reported per supported band for each type supported by the UE, details left to RAN2  Note:  - Type 1A refers to the determination of prioritization between DL PRS and other DL signals/channels in all OFDM symbols within the PRS processing window. The DL signals/channels from all DL CCs (per UE) are affected across LTE and NR  - Type 1B refers to the determination of prioritization between DL PRS and other DL signals/channels in all OFDM symbols within the PRS processing window. The DL signals/channels from a certain band are affected  - Type 2 refers to the determination of prioritization between DL PRS and other DL signals/channels only in DL PRS symbols within the PRS processing window  Note: When the UE determines higher priority for other DL signals/channels over the PRS measurement/processing, the UE is not expected to measure/process DL PRS which is applicable to all of the above capability options  Note: Within a PRS processing window, UE measurement is inside the active DL BWP with PRS having the same numerology as the active DL BWP  Note: Support of configuration of PRS processing window in RRC and support of using DL MAC CE to activate/deactivate the PRS processing window for PRS measurements is part of the FG , but no dedicated signaling is required.  A UE that supports [FG 58-2-10] must indicate this FG is supported | Optional with capability signalling |   **Proposal 5: Introduce the following Rel. 19 UE FG for UE-based positioning Case 1:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-10 | DL PRS Processing Capability outside MG - buffering capability for UE-based positioning Case 1 | 1. DL PRS buffering capability  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering  2a. 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  2b. Duration of DL PRS symbols N2 in units of ms a UE can process inT2 ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE  3. Max number of DL PRS resources that UE can process in a slot  4. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE for PRS measurement outside MG within the PPW | [58-2-9] | N/A | N/A | [FFS] | Per band | FFS | FFS | FFS | Component 1 candidate values: {Type 1, Type 2}  Component 2a candidate values:  a) T: {1, 2, 4, 8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  b) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Candidate 2b component values:  a) N2: {0.125, 0.25, 0.5, 1, 2, 3, 4, 5, 6, 8, 12} ms  b) T2: {4, 5, 6, 8} ms  Component 3 candidate values:  FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Component 4 candidate values:  FR1 bands: {5, 10, 20, 40, 50, 80, 100}  FR2 bands: {50, 100, 200, 400}  Need for location server to know if the feature is supported  Note 1:The (N, T) UE capabilities are interpreted as legacy (N, T) in [FG 58-2-4], and the UE is expected to receive the PRS within the PRS processing window and but the processing of the received PRS may be outside a PRS processing window.  The (N2, T2) UE capabilities are interpreted such that the UE is capable of measuring up to N2 ms PRS within a PPW and is capable of completing the PRS processing within the PPW, e.g., if the time duration from the last symbol of the measured PRS resource(s) inside the PPW, to the end of PPW is not smaller than T2 ms  Note 3: UE shall support either component 2a and component 2b , but not both for each supported type in a band  Note 4: A UE shall declare PRS processing capabilities of each of the supported Type-1A, Type-1B, Type-2 capabilities in case it supports multiple types in a band  A UE that supports [FG 58-2-9] must indicate this FG is supported  Note: if UE supports same values for one or more components as in FG 27-3-3, then the UE can skip indicating these components in this FG and the values in corresponding FG 27-3-3 components indicate supported PRS processing capabilities outside MG for Case 1 | Optional with capability signalling |   **Proposal 6: Introduce the following Rel. 19 UE FG for UE-based positioning Case 1:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-11 | Support of more than one activated PRS processing windows across all active DL BWPs for UE-based positioning Case 1 | 1. Number of supported activated PRS processing windows | [58-2-9] | N/A | N/A | DL PRS measurement outside MG and in a PRS processing window for UE-based positioning Case 1 is not supported | Per UE | FFS | FFS | FFS | Candidate values:{2, 3, 4} | Optional with capability signalling |   For AI/ML Case 1, UE can also indicate whether it supports AI/ML positioning in IDLE or INACTIVE modes along with corresponding PRS resource and processing features. We propose the following changes to existing FGs and new FGs:   * Support of PRS measurement in RRC\_INACTIVE state for UE-based positioning Case 1 * DL PRS processing capabilities in RRC inactive state for UE-based positioning Case 1 * Support of PRS measurement in RRC\_IDLE for UE-based positioning Case 1   In addition, if UE support component values same to common values of existing legacy methods, then UE can skip indicating those component(s). It is beneficial to indicate the UE can skip them and those indicated in other corresponding FGs become the baseline. We propose adding a note to indicate it (see newly proposed FG 58-2-13 below).  **Proposal 7: Introduce the following Rel. 19 UE FGs for UE-based positioning Case 1:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-12 | Support of UE-based positioning Case 1 in RRC\_INACTIVE state | UE-based positioning Case 1 in RRC\_INACTIVE state is supported | [58-2-3 and 58-2-13~~]~~ | N/A | N/A | UE-based positioning Case 1 in RRC\_INACTIVE state is not supported | Per Band | FFS | FFS | FFS | Support of UE-based positioning Case 1 in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signalling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-13 | DL PRS processing capabilities in RRC inactive state for UE-based positioning Case 1 | 1. DL PRS buffering capability  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering  2. 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  3. Max number of DL PRS resources that UE can process in a slot | [58-2-4] | N/A | N/A |  | Per band | FFS | FFS | FFS | Component 1 candidate values: {Type 1, Type 2}  Component 2 candidate values:  T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Component 3 candidate values:  FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Need for location server to know if the feature is supported  Note: Having the PRS processing capabilities in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state  Note: if UE supports same values for one or more components as in FG 27-6, then the UE can skip indicating these components in this FG and the values in corresponding FG 27-6 components indicate supported PRS processing capabilities in RRC inactive state for Case 1 | Optional with capability signalling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-14 | Support of UE-based positioning Case 1 in RRC\_IDLE | Support of UE-based positioning Case 1 in RRC\_IDLE | [ 58-2-4,  58-2-12,  58-2-13] | N/A | N/A | UE-based positioning Case 1 in RRC\_IDLE  is not supported | Per Band | FFS | FFS | FFS | Need for location server to know if the feature is supported | Optional with capability signalling |   RAN1 agreed to support assistance data for PRS/PRS bandwidth aggregation similar to UE-based DL-TdoA. Therefore, it is expected that their corresponding UE features that are provided for UE-based DL-TdoA need to be stated for Case 1. We propose to introduce the following FGs corresponding to PRS bandwidth aggregation features for Case 1:   * DL PRS processing capabilities for aggregated PRS processing of 2 PFLs in intra-band contiguous within a MG for RRC\_CONNECTED - UE-based positioning Case 1 * DL PRS processing capabilities for aggregated PRS processing of 3 PFLs in intra-band contiguous within a MG for RRC\_CONNECTED - UE-based positioning Case 1 * DL PRS processing capabilities for aggregated PRS processing of 2 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE - UE-based positioning Case 1 * DL PRS processing capabilities for aggregated PRS processing of 3 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE - UE-based positioning Case 1 * PRS bandwidth aggregation with two PFL combinations - UE-based positioning Case 1 * PRS bandwidth aggregation in RRC\_CONNECTED UE-based positioning Case 1 * PRS bandwidth aggregation in RRC\_ INACTIVE UE-based positioning Case 1 * PRS bandwidth aggregation in RRC\_IDLE - UE-based positioning Case 1   In addition, if UE support component values same as common values of existing legacy methods (when applicable), then UE can skip indicating those component(s). It is beneficial to indicate the UE can skip them and those indicated in other corresponding FGs become the baseline. We propose adding a note to indicate it (see newly proposed FGs 58-2-15/15a/15b/15c below).  **Proposal 8: Introduce the following Rel. 19 UE FGs for UE-based positioning Case 1:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-15 | DL PRS processing capabilities for aggregated PRS processing of 2 PFLs in intra-band contiguous within a MG for RRC\_CONNECTED - UE-based positioning Case 1 | 1. Maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE  2. Maximum DL PRS bandwidth in MHz, per PFL  3. DL PRS buffering capability  4. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE.  5. Maximum number of aggregated DL PRS resources across aggregated PFLs that UE can process in a slot | [58-2-4] | N/A | N/A | FFS | Per Band | FFS | FFS | FFS | Component 1 candidate values:  a) FR1 bands: {10, 20, 40, 50, 80, 100, 160, 200}  b) FR2 bands: {100, 200, 400, 800}  Component 2 candidate values:  a) FR1 bands: {5, 10, 20, 40, 50, 80, 100}  b) FR2 bands: {50, 100, 200, 400}  Note: Component 3 in this FG follows buffering capability type reported in [FG 58-2-4]  Component 4 candidate values:  a) T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  b) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Note: this value N should be equal or smaller than the value N reported by [FG 58-2-4], or this value T should be equal or larger than the value T reported by [FG 58-2-4]  Component 5 candidate values:  a. FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  b. FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Note: each two linked PRS resources are counted as 1 resource  Note: this value should be equal or smaller than the value reported by [FG 58-2-4]  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%  Note: if UE supports same values for one or more components as in FG 41-4-1, then the UE can skip indicating these components in this FG and the values in corresponding FG 41-4-1 components indicate supported aggregated PRS processing of 2 PFLs in intra-band contiguous within a MG for RRC\_CONNECTED for Case 1 | Optional with capability signalling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-15a | DL PRS processing capabilities for aggregated PRS processing of 3 PFLs in intra-band contiguous within a MG for RRC\_CONNECTED - UE-based positioning Case 1 | 1. Maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE  2. Maximum DL PRS bandwidth in MHz, per PFL  3. DL PRS buffering capability  4. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE.  5. Maximum number of aggregated DL PRS resources across aggregated PFLs that UE can process in a slot | [58-2-15] | N/A | N/A | FFS | Per Band | FFS | FFS | FFS | Component 1 candidate values:  a) FR1 bands: {15, 20, 30, 40, 50, 60, 80, 100, 120, 140, 150, 160, 180, 200, 240, 300}}  b) FR2 bands: {150, 200, 300, 400, 600, 800, 1000, 1200}  Component 2 candidate values:  a) FR1 bands: {5, 10, 20, 40, 50, 80, 100}  b) FR2 bands: {50, 100, 200, 400}  Note: Component 3 in [FG58-2-15a (this FG)] follows buffering capability type reported in [FG 58-2-4]  Component 4 candidate values:  a) T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  b) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Note: this value N should be equal or smaller than the value N reported by [FG 58-2-4] or this value T should be equal or larger than the value T reported by [FG 58-2-4]  Component 5 candidate values:  a. FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  b. FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Note: each three linked PRS resources are counted as 1 resource  Note: this value should be equal or smaller than the value reported by [FG 58-2-4]  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%  Note: if UE supports same values for one or more components as in FG 41-4-1a, then the UE can skip indicating these components in this FG and the values in corresponding FG 41-4-1a components indicate supported aggregated PRS processing of 3 PFLs in intra-band contiguous within a MG for RRC\_CONNECTED for Case 1 | Optional with capability signalling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-15b | DL PRS processing capabilities for aggregated PRS processing of 2 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE - UE-based positioning Case 1 | 1. Maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE  2. Maximum DL PRS bandwidth in MHz, per PFL  3. DL PRS buffering capability  4. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE.  5. Maximum number of aggregated DL PRS resources across aggregated PFLs that UE can process in a slot | [58-2-13] | N/A | N/A | FFS | Per Band | FFS | FFS | FFS | Component 1 candidate values:  a) FR1 bands: {10, 20, 40, 50, 80, 100, 160, 200}  b) FR2 bands: {100, 200, 400, 800}  Component 2 candidate values:a) FR1 bands: {5, 10, 20, 40, 50, 80, 100}  b) FR2 bands: {50, 100, 200, 400}  Note: Component 3 in [FG 58-2-15b (this FG)] follows buffering capability type reported in [FG 58-2-4]  Component 4 candidate values:  a) T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  b) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Note: this value N should be equal or smaller than the value N reported by [FG 58-2-13] or this value T should be equal or larger than the value T reported by [FG 58-2-13]  Component 5 candidate values:  a. FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  b. FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Note: each two linked PRS resources are counted as 1 resource  Note: this value should be equal or smaller than the value reported by [FG 58-2-13]  Note: if UE supports same values for one or more components as in FG 41-4-1b, then the UE can skip indicating these components in this FG and the values in corresponding FG 41-4-1b components indicate supported for aggregated PRS processing of 2 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE capabilities for Case 1 | Optional with capability signalling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-15c | DL PRS processing capabilities for aggregated PRS processing of 3 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE - UE-based positioning Case 1 | 1. Maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE  2. Maximum DL PRS bandwidth in MHz, per PFL  3. DL PRS buffering capability  4. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE.  5. Max number of aggregated DL PRS resources across aggregated PFLs that UE can process in a slot under it | [58-2-15b] | N/A | N/A | FFS | Per Band | FFS | FFS | FFS | Component 1 candidate values:  a) FR1 bands: {15, 20, 30, 40, 50, 60, 80, 100, 120, 140, 150, 160, 180, 200, 240, 300}  b) FR2 bands: {150, 200, 300, 400, 600, 800, 1000, 1200}  Component 2 candidate values:  a) FR1 bands: {5, 10, 20, 40, 50, 80, 100}  b) FR2 bands: {50, 100, 200, 400}  Note: Component 3 in [FG 58-2-15c (this FG)~~]~~ follows buffering capability type reported in [FG 58-2-4]  Component 4 candidate values:  a) T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  b) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Note: this value N should be equal or smaller than the value N reported by [FG 58-2-13] or this value T should be equal or larger than the value T reported by [FG 58-2-13]  Component 5 candidate values:  a. FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  b. FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Note: each three linked PRS resources are counted as 1 resource  Note: this value should be equal or smaller than the value reported by [FG 58-2-13]  Note: if UE supports same values for one or more components as in FG 41-4-1c, then the UE can skip indicating these components in this FG and the values in corresponding FG 41-4-1c components indicate supported aggregated PRS processing of 3 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE for Case 1 | Optional with capability signalling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-16 | PRS bandwidth aggregation with two PFL combinations - UE-based positioning Case 1 | Support of PRS bandwidth aggregation with two PFL combinations for UE-based positioning Case 1 | [58-2-15] | N/A | N/A | PRS bandwidth aggregation with two PFL combinations for UE-based positioning Case 1 is not supported | Per Band | FFS | FFS | FFS | Need for location server to know if the feature is supported.  Note: More than one combination are measured in TDMed manner | Optional with capability signalling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-17 | PRS bandwidth aggregation in RRC\_CONNECTED UE-based positioning Case 1 | Support of PRS bandwidth aggregation in RRC\_CONNECTED for UE-based positioning Case 1 | [58-2-3, 58-2-15] | N/A | N/A | PRS bandwidth aggregation in RRC\_CONNECTED for UE-based positioning Case 1 is not supported | Per Band | FFS | FFS | FFS | Need for location server to know if the feature is supported. | Optional with capability signalling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-18 | PRS bandwidth aggregation in RRC\_ INACTIVE UE-based positioning Case 1 | Support of PRS bandwidth aggregation in RRC\_ INACTIVE for UE-based positioning Case 1 | [58-2-12, 58-2-15b] | N/A | N/A | PRS bandwidth aggregation in RRC\_ INACTIVE for UE-based positioning Case 1 is not supported | Per Band | FFS | FFS | FFS | Need for location server to know if the feature is supported. | Optional with capability signalling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-19 | PRS bandwidth aggregation in RRC\_IDLE - UE-based positioning Case 1 | Support of PRS bandwidth aggregation in RRC\_IDLE for UE-based positioning Case 1 | [58-2-14, 58-2-15b] | N/A | N/A | PRS bandwidth aggregation in RRC\_IDLE  for UE-based positioning Case 1 is not supported | Per Band | FFS | FFS | FFS | Need for location server to know if the feature is supported. | Optional with capability signalling |   For AI/ML Case 1, UE can also indicate whether it supports low latency MG activation, similar to other positioning methods. We propose the following change to existing FG:  **Proposal 9: Introduce the following change for UE-based positioning Case 1:**   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 27. NR\_pos\_enh | 27-10a | Low latency MG activation request for PRS measurements | support of low latency MG activation request for PRS measurements | 27-10, 27-11 | *mg-ActivationRequest-r17* | *LPP*  *NR-DL-TDOA-ProvideCapabilities-r16*  *NR-DL-AoD-ProvideCapabilities-r16*  *NR-Multi-RTT-ProvideCapabilities-r16*  *NR-UE-based-PositioningCase1-ProvideCapabilities-r19* | No | No | Need for location server to know if the feature is supported  Note: RAN1 understands that FG 27-10a is intended only for the LMF to know, and that the current prerequisite FGs of FG 27-10a are capabilities only for the gNB to know. It is up to RAN2 to decide whether such a FG dependency is meaningful from signaling description perspective, and whether and how it can be captured in RAN2 specifications. | Optional with capability signaling |   RAN1 agreed to support assistance data for PRS TEG and LOS/NLOS indicator AD as in UE-based DL-TdoA. Therefore, it is expected that their corresponding RAN1 UE features to be provided for Case 1. We propose to introduce FGs corresponding to these RAN1 AD features for Case 1, as follows  **Proposal 10: Introduce the following Rel. 19 UE FGs for UE-based positioning Case 1:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-2-20 | Support of PRS TEG association information for UE-based positioning Case 1 | Support of reception of association between PRS and TRP Tx TEG for UE-based positioning Case 1 | [58-2-4] | N/A | N/A | Reception of PRS TEG association information for UE-based positioning Case 1 is not supported | Per UE | FFS | FFS | FFS | Need for location server to know if the feature is supported. | Optional with capability signalling |   **Proposal 11: Introduce the following change for UE-based positioning Case 1:**   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 27. NR\_pos\_enh | 27-12 | LOS/NLOS indicator for UE-based positioning assistance data | Support reception of the assistance data containing the LOS/NLOS indicator.  1. LOS/NLOS indicator type  2. LOS/NLOS indicator granularity |  | *nr-los-nlos-IndicatorSupport-r17* | *NR-DL-TDOA-ProvideCapabilities-r16*  *NR-DL-AoD-ProvideCapabilities-r16*  *NR-Multi-RTT-ProvideCapabilities-r16*  *[NR-Case1-ProvideCapabilities]* | No | No | Component 1 candidate values: {hardValue+softValue, hardValue}  Component 2 candidate values: {resourceSpecific, trpSpecific}  Need for location server to know if the feature is supported. | Optional with capability signaling. | |
| NTT DOCOMO, INC. [16] |  |

## Specification support for CSI prediction

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. NR\_AIML\_Air | 58-3-1 | CSI prediction for UE-sided inference when N4=1 | 1. Support of CSI prediction for UE-sided inference when N4=1  2. Support for reporting predicted PMI with N4=1  3. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  5. Support parameter combinations with L=2,4  6. Support for rank = 1,2  7. Support for the size of DD-basis, N4=1  8. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  [9. Value for CPU occupation, when P/SP-CSI-RS is configured for CMR]  [10. Value for CPU occupation, when A-CSI-RS is configured for CMR]  11. Scaling factor for active resource counting Kp | 2-35 | yes | n/a | CSI prediction for N4=1 for inference is not supported | [Per band and Per BC] | n/a | n/a | n/a |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Ericsson [2] | The CPU occupation components in FG 58-3-1 need to be updated based on the latest RAN1 agreements. To reduce the complexity for NW to handle many different combinations of PU occupancies, a limited number of values should be supported. In addition, a new component needs to be added to support the value *t* for CSI processing time. Introducing positive values of *t* implies that AI based CSI prediction requires longer CSI processing time than legacy Rel-18 CSI prediction, which makes this AI feature less useful. In RAN1 discussions, companies have indicated that shortened inference latency can be achieved compared to non-AI based scheme if using dedicated AI hardware and high degree of parallelization for AI based CSI processing (e.g., matrix operations). Hence, negative values of *t* shall be supported.   1. Add the following components to the basic feature group 58-3-1 for Rel-19 CSI prediction using UE-sided model:    * Value of N for APU occupation, limit the number of candidate values    * Value of M for CPU occupation, limit the number of candidate values    * APU pool index when supporting 2 APU pools    * Value of t for CSI processing time, limit the number of candidate values and shall at least include negative values |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-1 | CSI prediction for UE-sided inference when N4=1 | 1. Support of CSI prediction for UE-sided inference when N4=1  2. Support for reporting predicted PMI with N4=1  3. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  5. Support parameter combinations with L=2,4  6. Support for rank = 1,2  7. Support for the size of DD-basis, N4=1  8. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  [9. Indicate the additional CPU pool used for this feature]  10. Values for CPU occupation in CPU and additional CPU pools, when P/SP-CSI-RS is configured for CMR  11. Value for CPU occupation in CPU and additional CPU pools, when A-CSI-RS is configured for CMR  12. Scaling factor for active resource counting Kp | 2-35, 58-0-1 | yes | n/a | CSI prediction for N4=1 for inference is not supported | Per band and Per BC | n/a | n/a | n/a | Component 3 candidate values  a. {4,8,12,16,24,32}  b. {2,3,4 … 64}  c. {4, …, 256}  Component 9 candidate values: {1,2}  Component 10 candidate values: {1, 2, 3}  Note: A UE that supports CSI prediction for UE-sided inference must support this FG  [Component 9 candidate values: {1,2} where 2 is allowed only if 2 additional CPU pools are supported.]  [Components 10 and 11 have values for the CPU pool and the additional CPU pool.]  [In each component, at least one value must be greater than zero.] | Optional with capability signalling | |
| CATT/CICTCI [4] |  |
| Huawei/HiSilicon [5] |  |
| Vivo [6] | |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-1 | CSI prediction for UE-sided inference when N4=1 | 1. Support of CSI prediction for UE-sided inference when N4=1  2. Support for reporting predicted PMI with N4=1  3. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  5. Support parameter combinations with L=2,4  6. Support for rank = 1,2  7. Support for the size of DD-basis, N4=1  8. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  ~~[~~9. Value for CPU occupation, when P/SP-CSI-RS is configured for CMR]  [10. Value for CPU occupation, when A-CSI-RS is configured for CMR~~]~~  11. Scaling factor for active resource counting Kp  12. Supported values of the maximum number of observation number | 2-35 | yes | CSI prediction for N4=1 for inference is not supported |  | |
| Xiaomi [7] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-1 | CSI prediction for UE-sided inference when N4=1 | 1. Support of CSI prediction for UE-sided inference when N4=1  2. Support for reporting predicted PMI with N4=1  3. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  5. Support parameter combinations with L=2,4  6. Support for rank = 1,2  7. Support for the size of DD-basis, N4=1  8. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  9. Value for PU occupation, when P/SP-CSI-RS is configured for CMR]  10. Value for PU occupation, when A-CSI-RS is configured for CMR  11. Scaling factor for active resource counting Kp | 2-35 | yes | n/a | CSI prediction for N4=1 for inference is not supported | Per band and Per BC | n/a | n/a | n/a | Compontent 9:  when P/SP-CSI-RS is configured for CMR,  , M  , N.  Compontent 10:  when A-CSI-RS is configured for CMR and K<12, where where K is the number of A-CSI-RS resources..  ,  When K=12  , M=[0,8]  N=[0,8] | Optional with capability signalling | |
| ZTE Corporation/Sanechips [8] | ***Proposal 9****: Regarding FG58-3-1 and FG58-3-2, UE reports the occupied CPU and/or AIMLPU.* |
| Samsung [9] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-1 | AI/ML based CSI prediction for UE-sided model when N4=1 | 1. Support of AI/ML based CSI prediction  2. Support for reporting predicted PMI with N4=1  3. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  5. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  6. Support parameter combinations with L=2,4  7. Support for rank = 1,2  8. Value for CPU and APU occupation, when P/SP-CSI-RS is configured for CMR  9. Value for CPU and APU occupation, when A-CSI-RS is configured for CMR  10. Support for the size of DD-basis, N4=1  11. Scaling factor for active resource counting Kp  12. supported value of t for the relaxation of Zand Z’ timeline | FFS | yes | n/a | CSI prediction for N4=1 is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling | |
| Ofinno [10] |  |
| OPPO [11] | Regarding the 58-3-1 FG of CSI prediction on UE-sided inference when N4=1:   * Component 9/10: besides CPU occupation, AI/ML PU occupation when P/SP/AP is configured for CMR should also be considered  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-1 | CSI prediction for UE-sided inference when N4=1 | 1. Support of CSI prediction for UE-sided inference when N4=1  2. Support for reporting predicted PMI with N4=1  3. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  5. Support parameter combinations with L=2,4  6. Support for rank = 1,2  7. Support for the size of DD-basis, N4=1  8. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  9. Value for CPU/AIML PU occupation, when P/SP-CSI-RS is configured for CMR  10. Value for CPU/AIML PU occupation, when A-CSI-RS is configured for CMR]  11. Scaling factor for active resource counting Kp | 2-35 | yes | n/a | CSI prediction for N4=1 for inference is not supported | [Per band and Per BC] | n/a | n/a | n/a | Candidate values for CPU/AIML PU: FFS | Optional with capability signalling | |
| LG Electronics [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-1 | CSI prediction for UE-sided inference when N4=1 | 1. Support of CSI prediction for UE-sided inference when N4=1  2. Support for reporting predicted PMI with N4=1  3. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  5. Support parameter combinations with L=2,4  6. Support for rank = 1,2  7. Support for the size of DD-basis, N4=1  8. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  ~~[~~9. Value for APU and/or CPU occupation, when P/SP-CSI-RS is configured for CMR~~]~~  ~~[~~10. Value for APU and/or CPU occupation, when A-CSI-RS is configured for CMR~~]~~  11. Scaling factor for active resource counting Kp  12. The number of additional symbols, t\_i, between the last symbol of CSI-RS and the first symbol of the transmission channel containing predicted CSI report, where  i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS  13. The number of additional symbols, t\_i’, between the last symbol of CSI-RS and the first symbol of the transmission channel containing predicted CSI report, where  i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS | 2-35 | yes | n/a | CSI prediction for N4=1 for inference is not supported | ~~[~~Per band and Per BC~~]~~ | n/a | n/a | n/a | [Component 3 candidate values:  a. {4,8,12,16,24,32}  b. {2,3,4 … 64}  c. {4, …, 256}  ]  [Component 9 candidate values:  a. FFS  b. FFS  ]  [Component 10 candidate values:  a. FFS  b. FFS  ]  [Component 11 candidate values: {1, 2, 4}]  [Component 12 FFS on candidate values]  [Component 13 FFS on candidate values] | Optional with capability signalling | |
| Apple [13] | **Proposal 3-1: Update the UE FGs 58-3-1 and FG58-3-2 to capture the AI/ML PU (OAPU) and/or legacy CPU (OCPU), and CSI computation time, add the following components:**  **9. Value for CPU occupation, when P/SP-CSI-RS is configured for CMR**  **10. Value for CPU occupation, when A-CSI-RS is configured for CMR**  **11. Value for APU occupation, when P/SP-CSI-RS is configured for CMR**  **12. Value for APU occupation, when A-CSI-RS is configured for CMR**  **13. Value for additional CSI computation time per SCS** |
| CMCC [14] | It is supported to make UE report the number of APU and CPU for AI/ML based CSI prediction, but it is not related with the time domain property. And combination of OAPU= 0 and OCPU=0 is not allowed. So, we think component 9 and 10 is basically needed with the following modifications:   * 9. Value for APU occupation * 10. Value for CPU occupation   As for the candidate value of APU and CPU, at least value 0 should be included.  Besides, now that we support to include component 11 in FG 59-3-1, which can be seen as number of observation number, then the component 8 of FG 59-3-2 is not needed since the prerequisite of FG 59-3-2 is FG 59-3-1.  Based on the above analyses, we suggest taking the following modifications (in red) for the feature of Rel-19 AI based CSI prediction.  ***Proposal 7: Take the following modification (in red) for the feature of Rel-19 AI based CSI prediction:***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-1 | CSI prediction for UE-sided inference when N4=1 | 1. Support of CSI prediction for UE-sided inference when N4=1  2. Support for reporting predicted PMI with N4=1  3. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  5. Support parameter combinations with L=2,4  6. Support for rank = 1,2  7. Support for the size of DD-basis, N4=1  8. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  ~~[~~9. Value for APU occupation~~, when P/SP-CSI-RS is configured for CMR]~~  ~~[~~10. Value for CPU occupation~~, when A-CSI-RS is configured for CMR]~~  11. Scaling factor for active resource counting Kp | 2-35 | yes | n/a | CSI prediction for N4=1 for inference is not supported | [Per band and Per BC] | n/a | n/a | n/a | Candidate value of number of APU and CPU: at least value 0 is supported  Note: Combination of OAPU= 0 and OCPU=0 is not allowed | Optional with capability signalling | |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-1 | CSI prediction for UE-sided inference when N4=1 | 1. Support of CSI prediction for UE-sided inference when N4=1  2. Support for reporting predicted PMI with N4=1  3. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  5. Support parameter combinations with L=2,4  6. Support for rank = 1,2  7. Support for the size of DD-basis, N4=1  ~~[~~8. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)~~]~~  [9. O\_CPU value]  [10. O\_APU value]  ~~[~~11. Scaling factor for active resource counting Kp~~]~~ | 2-35 | yes | n/a | CSI prediction for N4=1 for inference is not supported | [Per band and Per BC] | n/a | n/a | n/a | ~~FFS: CPU/AIMLPU related information~~  Candidate values for component 3:  - Maximum 16 triplets  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256}  Candidate values for component 9: {1…8}  Candidate values for component 10: {0…8} | Optional with capability signalling | |
| NTT DOCOMO, INC. [16] | In the last meeting, a common FG (i.e., FG 58-0-1) for all CSI-related AI/ML use cases was defined, and it should be the prerequisite for all FGs of the CSI-related AI/ML use cases where UE-side inference is involved. Therefore, the prerequisite of FG58-3-1 should include FG 58-0-1, the newly introduced FG.  Another issue is the APU occupation for the UE-side CSI prediction, a new component should be introduced to reflect the following agreement from RAN1#121.   |  | | --- | | Agreement  For CSI prediction using UE-side model, to calculate the inference report using Doppler codebook,   * For PU occupancy, support   + Dedicated AI/ML PU (OAPU) and/or legacy CPU (OCPU) are occupied,     - OAPU= 0 or N is reported by UE     - OCPU=0 or M is reported by UE     - Note: Detailed values of N and M can be further discussed in UE feature.     - Note: Combination of OAPU= 0 and OCPU=0 is not allowed     - Note: if any of the unoccupied PU cannot satisfy the corresponding required PU by the CSI report, the CSI report will follow the legacy behaviour of exceeding the CPU limit, neither of the PUs are occupied |   It is noted in the agreements that detailed values of N and M can be further discussed in UE feature. For APU (i.e., CPU\_2 in current specification) occupations, if a UE can report arbitrary number, there will be no consensus on the understanding of the APU between NW and UE. The maximum APU resources reported by UE is meaningless then. The NW cannot manage the configurations for UEs to fully utilize the AI/ML capability of UEs in the network. To avoid this and meanwhile to reflect the different UE implementations with different model size, we suggest the restrictions on the candidate values of O\_APU. For example, N\_small = 2 and N\_large = 4 besides the value 0 for UE using small- or large-scale models. Therefore, we have similar proposals about the APU/CPU occupations as the beam management part.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-1 | CSI prediction for UE-sided inference when N4=1 | 1. Support of CSI prediction for UE-sided inference when N4=1  2. Support for reporting predicted PMI with N4=1  3. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  5. Support parameter combinations with L=2,4  6. Support for rank = 1,2  7. Support for the size of DD-basis, N4=1  8. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  ~~[~~9. Value for CPU\_1 occupation. ~~when P/SP-CSI-RS is configured for CMR]~~  ~~[10. Value for CPU occupation, when A-CSI-RS is configured for CMR]~~  11. Scaling factor for active resource counting Kp  12. Index about which APU pool is CPU\_2  13. Value for CPU\_2 occupation. | 58-0-1 | yes | n/a | CSI prediction for N4=1 for inference is not supported | ~~[~~Per band and per BC~~]~~ | n/a | n/a | n/a | Candidate values for component 9: {0, 1, 8}  Candidate values for component 12: {1,2}  Candidate values for component 13: {1,2,4} | Optional with capability signalling | |

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| 58. NR\_AIML\_Air | 58-3-1a-1 | DD unit size when A-CSI-RS is configured for CMR N4>1 for UE side inference of CSI prediction | Value of d=1 for the DD unit size when A-CSI-RS for inference is configured for CMR | 58-3-1 | Yes | N/A | DD unit size d=1 is not supported when A-CSI-RS is configured for CMR N4>1 for UE side inference of CSI prediction | Per-band  and Per-BC | N/A | N/A | N/A |  | Optional with capability signaling |

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| Vivo [6] |  |
| Xiaomi [7] |  |
| ZTE Corporation/Sanechips [8] |  |
| Samsung [9] |  |
| Ofinno [10] |  |
| OPPO [11] |  |
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| 58. NR\_AIML\_Air | 58-3-1b | Maximum number of aperiodic CSI-RS resources that can be configured in the same CSI report setting for Rel-16-based doppler measurement for UE side inference of CSI prediction | 1. Maximum number of aperiodic CSI-RS resources for inference that can be configured in the same CSI report setting for Rel-16-based doppler measurement | 58-3-1 | Yes | N/A | Maximum number of aperiodic CSI-RS resources that can be configured in the same CSI report setting for Rel-16-based doppler measurement for UE side inference of CSI prediction is not known | Per-band  and Per-BC | N/A | N/A | N/A | Component 1 candidate values: {4, 8, 12} | Optional with capability signaling |

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| ZTE Corporation/Sanechips [8] |  |
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| 58. NR\_AIML\_Air | 58-3-1-2 | Support R=2 for Rel-16-based doppler codebook for UE side inference of CSI prediction | A list of supported combinations {Max # of Tx ports in one resource for inference, Max # of resources for inference and total # of Tx ports}, across all CCs simultaneously, with R=2 | 58-3-1 | Yes | N/A | R=2 for Rel-16-based doppler codebook for UE side inference of CSI prediction is not supported | Per band and per BC | N/A | N/A | N/A | Candidate values for component 1:  - Maximum 16 triplets  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256} | Optional with capability signaling |

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| 58. NR\_AIML\_Air | 58-3-1-3 | Support X=1 based on first and last slot of WCSI, for Rel-16-based doppler codebook for UE side inference of CSI prediction | Support of TDCQI = ‘1-2’ | 58-3-1 | Yes | N/A | X=1 based on first and last slot of WCSI, for Rel-16-based doppler codebook for UE side inference of CSI prediction is not supported | Per band and per BC | N/A | N/A | N/A |  | Optional with capability signaling |

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| 58. NR\_AIML\_Air | 58-3-1-3a | Support X=2 CQI based on 2 slots for Rel-16-based doppler codebook for UE side inference of CSI prediction | Support of TDCQI = ‘2’ | 58-3-1 | Yes | N/A | X=2 CQI based on 2 slots for Rel-16-based doppler for UE side inference of CSI prediction is not supported | Per band and per BC | N/A | N/A | N/A |  | Optional with capability signaling |

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| 58. NR\_AIML\_Air | 58-3-1-4 | support of l = (n – nCSI,ref ) for CSI reference slot for Rel-16 based doppler codebook for UE side inference of CSI prediction | 1. Support of l = (n – nCSI,ref ) for CSI reference slot when N4=1 and d>1  2. Support of l = (n – nCSI,ref ) for CSI reference slot when N4>1 | 58-3-1 | Yes | N/A | l = (n – nCSI,ref ) for CSI reference slot for Rel-16 based doppler codebook for UE side inference of CSI prediction is not supported | Per band and per BC | N/A | N/A | N/A |  | Optional with capability signaling |

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| 58. NR\_AIML\_Air | 58-3-1-5 | Support of L=6 for Rel-16 based doppler codebook for UE side inference of CSI prediction | Support of L=6 for Rel-16 based doppler codebook | 58-3-1 | Yes | N/A | L=6 for Rel-16-based doppler codebook for UE side inference of CSI prediction is not supported | Per band and per BC | N/A | N/A | N/A |  | Optional with capability signaling |

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| X. NR\_AIML\_Air | 58-3-1-6 | Support of rank equals 3 and 4 for Rel-16 based doppler codebook for UE side inference of CSI prediction | Support of rank equals 3 and 4 for Rel-16 based doppler codebook | 58-3-1 | Yes | N/A | Rank equals 3 and 4 for Rel-16-based doppler codebook for UE side inference of CSI prediction is not supported | Per band and per BC | N/A | N/A | N/A |  | Optional with capability signaling |

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| 58. NR\_AIML\_Air | 58-3-1-7 | Active CSI-RS resources and ports for mixed R16 based doppler codebook for CSI prediction via UE side model with other codebooks in any slot | 1. List of codebook combinations of two types  2. List of {max number of ports per resource, max number of resources, max number of total ports} for each codebook combination | 23-9-1, 16-3a, 2-36, 2-40, 2-41, 23-9-2, 23-9-4, 40-3-2-1, 40-3-2-1a, 40-3-2-2, X-1-1, X-1-1a, X-1-2 | Yes | n/a | Active CSI-RS resources and ports for mixed R16 based doppler codebook for CSI prediction via UE side model with other codebooks in any slot is not supported | Per band and Per BC | n/a | n/a | n/a | Component 1 candidate values:  FFS  Component 2 candidate values:  FFS  Note: if a UE reports one or more codebook combinations in 58-3-1-7, then usage of active CSI-RS resources and ports for multiple codebooks in any slot is allowed only within those combinations  Note: For coexisting of mixed codebooks in any slot, gNB need to honor 16-8, 23-9-5, 58-3-1-7 and per-codebook capability 2-36/40/41, 16-3a, and 23-9-1/23-9-2/23-9-4.  [Note: Up to 4 combinations for component 1] | Optional with capability signaling |

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| Ofinno [10] |  |
| OPPO [11] |  |
| LG Electronics [12] |  |
| Apple [13] |  |
| CMCC [14] |  |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-1-7 | Active CSI-RS resources and ports for mixed R16 based doppler codebook for CSI prediction via UE side model with other codebooks in any slot | 1. List of codebook combinations of two types  2. List of {max number of ports per resource, max number of resources, max number of total ports} for each codebook combination | 23-9-1, 16-3a, 2-36, 2-40, 2-41, 23-9-2, 23-9-4, 40-3-2-1, 40-3-2-1a, 40-3-2-2, X-1-1, X-1-1a, X-1-2 | Yes | n/a | Active CSI-RS resources and ports for mixed R16 based doppler codebook for CSI prediction via UE side model with other codebooks in any slot is not supported | Per band and Per BC | n/a | n/a | n/a | Component 1 candidate values:  {Type I SP, CSI prediction for UE-sided inference when N4=1 and R=1}  {Type I SP, CSI prediction for UE-sided inference when N4>1 and R=1}  {eType II R=1, CSI prediction for UE-sided inference when N4=1 and R=1}  {eType II R=1, CSI prediction for UE-sided inference when N4>1 and R=1}  Component 2 candidate values:  - Maximum 16 triplets  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256}  Note: if a UE reports one or more codebook combinations in 58-3-1-7, then usage of active CSI-RS resources and ports for multiple codebooks in any slot is allowed only within those combinations  Note: For coexisting of mixed codebooks in any slot, gNB need to honor 16-8, 23-9-5, 58-3-1-7 and per-codebook capability 2-36/40/41, 16-3a, and 23-9-1/23-9-2/23-9-4.  [Note: Up to 4 combinations for component 1] | Optional with capability signaling | |
| NTT DOCOMO, INC. [16] |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. NR\_AIML\_Air | 58-3-2 | CSI prediction for UE-sided inference when N4>1 | 1. Support of CSI prediction for UE-sided inference when N4>1  2. Support for reporting predicted PMI with N4>1  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR  5. Support for the size of DD-basis, N4>1  7. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting  [8. Supported values of the maximum number of observation number] | 58-3-1 | yes | n/a | CSI prediction for N4>1 for inference is not supported | [Per band and Per BC] | FFS | FFS | FFS | FFS: CPU/AIMLPU related information  Candidate values: FFS | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Ericsson [2] |  |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-2 | CSI prediction for UE-sided inference when N4>1 | 1. Support of CSI prediction for UE-sided inference when N4>1  2. Support for reporting predicted PMI with N4>1  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR  5. Support for the size of DD-basis, N4>1  7. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting  [8. Supported values of the maximum number of observation number] | 58-3-1 | yes | n/a | CSI prediction for N4>1 for inference is not supported | Per band and Per BC | N/A | N/A | N/A | FFS:  Candidate values: FFS | Optional with capability signalling | |
| CATT/CICTCI [4] |  |
| Huawei/HiSilicon [5] | **Components for 58-3-2**   * Component 8: It needs more clarification: for A-CSI-RS, the max number of CSI-RS resources can be reflected by an additional FG, similar to FG 40-3-2-1b of Rel-18 CSI prediction. For P/SP-CSI-RS, there seems no need to reflect this UE capability since it is UE implementation.  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-2 | CSI prediction for UE-sided inference when N4>1 | 1. Support of CSI prediction for UE-sided inference when N4>1  2. Support for reporting predicted PMI with N4>1  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR  5. Support for the size of DD-basis, N4>1  7. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting  ~~[8. Supported values of the maximum number of observation number]~~ | 58-3-1 | yes | n/a | CSI prediction for N4>1 for inference is not supported | [Per band and Per BC] |  | FFS: CPU/AIMLPU related information  Candidate values: FFS |  | |
| Vivo [6] | |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-2 | CSI prediction for UE-sided inference when N4>1 | 1. Support of CSI prediction for UE-sided inference when N4>1  2. Support for reporting predicted PMI with N4>1  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR  5. Support for the size of DD-basis, N4>1  7. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting  ~~[~~8. Supported values of the maximum number of observation number~~]~~ | 58-3-1 | yes | CSI prediction for N4>1 for inference is not supported | FFS: CPU/AIMLPU related information  Candidate values: FFS | |
| Xiaomi [7] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-2 | CSI prediction for UE-sided inference when N4>1 | 1. Support of CSI prediction for UE-sided inference when N4>1  2. Support for reporting predicted PMI with N4>1  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR  5. Support for the size of DD-basis, N4>1  6. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting  7. Value for CPU occupation, when P/SP-CSI-RS is configured for CMR  8. Value for CPU occupation, when A-CSI-RS is configured for CMR | 58-3-1 | yes | n/a | CSI prediction for N4>1 for inference is not supported | Per band and Per BC | n/a | n/a | n/a | Component 3 candidate values  a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {2,3,4 … 64}  d. {4, …, 256}  Component 6 Candidate values  a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {4,8,12}  d.{4, …, 256}  Component 7  when P/SP-CSI-RS is configured for CMR,  ,  , .  Component 8  when A-CSI-RS is configured for CMR and K<12, where where K is the number of A-CSI-RS resources.  ,  When K=12  , M=[0,8]  N=[0,8] | Optional with capability signalling | |
| ZTE Corporation/Sanechips [8] | ***Proposal 9****: Regarding FG58-3-1 and FG58-3-2, UE reports the occupied CPU and/or AIMLPU.* |
| Samsung [9] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-2 | AI/ML based CSI prediction for UE-sided model when N4>1 | 1. Support of CSI prediction  2. Supported values of the number of future time instance.  3. Supported values of the maximum number of observation number  4. Support for reporting predicted PMI with N4>1  5. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  6. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting  7. Support for the size of DD-basis, N4>1  8. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs simultaneously  9. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting  10. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR  11. Supported values of the maximum number of resources for measurement  12. Supported values of the maximum number of future time instance | FFS | yes | n/a | CSI prediction for N4>1 is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling | |
| Ofinno [10] |  |
| OPPO [11] | Regarding the 58-3-2 FG of CSI prediction on UE-sided inference when N4=4:   * Component 58 is needed * Add CPU and AI/ML PU occupation when P/SP/AP is configured for CMR  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-2 | CSI prediction for UE-sided inference when N4>1 | 1. Support of CSI prediction for UE-sided inference when N4>1  2. Support for reporting predicted PMI with N4>1  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR  5. Support for the size of DD-basis, N4>1  7. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting  8. Supported values of the maximum number of observation number  9. Value of CPU/AIML PU occupation, when P/SP CSI-RS is configured for CMR  10. Value of CPU/AIML PU occupation, when A-CSI-RS is configured for CMR | 58-3-1 | yes | n/a | CSI prediction for N4>1 for inference is not supported | [Per band and Per BC] | FFS | FFS | FFS | Candidate values: FFS | Optional with capability signalling | |
| LG Electronics [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | X. NR\_AIML\_Air | 58-3-2 | CSI prediction for UE-sided inference when N4>1 | 1. Support of CSI prediction for UE-sided inference when N4>1  2. Support for reporting predicted PMI with N4>1  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR  5. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting | 58-3-1 | yes | N/A | CSI prediction for N4>1 for inference is not supported | ~~[~~Per band and Per BC~~]~~ | N/A | N/A | N/A | [Component 2 candidate values:  a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {2,3,4 … 64}  d. {4, …, 256}  [Component 5 Candidate values  a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {4,8,12}  d.{4, …, 256}}  ]  Note: FFS on how to handle applicability report, e.g., Multiple candidate values at least for N4={1,2,4,8} can be reported . | Optional with capability signalling | |
| Apple [13] | **Proposal 3-1: Update the UE FGs 58-3-1 and FG58-3-2 to capture the AI/ML PU (OAPU) and/or legacy CPU (OCPU), and CSI computation time, add the following components:**  **9. Value for CPU occupation, when P/SP-CSI-RS is configured for CMR**  **10. Value for CPU occupation, when A-CSI-RS is configured for CMR**  **11. Value for APU occupation, when P/SP-CSI-RS is configured for CMR**  **12. Value for APU occupation, when A-CSI-RS is configured for CMR**  **13. Value for additional CSI computation time per SCS** |
| CMCC [14] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-2 | CSI prediction for UE-sided inference when N4>1 | 1. Support of CSI prediction for UE-sided inference when N4>1  2. Support for reporting predicted PMI with N4>1  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR  5. Support for the size of DD-basis, N4>1  7. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting  ~~[~~8. Supported values of the maximum number of observation number~~]~~ | 58-3-1 | yes | n/a | CSI prediction for N4>1 for inference is not supported | [Per band and Per BC] | FFS | FFS | FFS | FFS: CPU/AIMLPU related information  Candidate values: FFS | Optional with capability signalling | |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-2 | CSI prediction for UE-sided inference when N4>1 | 1. Support of CSI prediction for UE-sided inference when N4>1  2. Support for reporting predicted PMI with N4>1  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR  ~~[~~5. Support for the size of DD-basis, N4>1~~]~~  ~~[6. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs simultaneously]~~  ~~[~~7. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting~~]~~  [8. Supported values of the maximum number of observation number]  [9. O\_CPU value]  [10. O\_APU value]  ~~Candidate values: {FFS}]~~ | 58-3-1 | yes | n/a | CSI prediction for N4>1 for inference is not supported | [Per band and Per BC] | FFS | FFS | FFS | FFS: CPU/AIMLPU related information  Candidate values: FFS  Candidate values for component 3:  - Maximum 16 quadruplets  - Max N4:{1,2,4,8}  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256}  Candidate values for component 9: {1…8}  Candidate values for component 10: {0…8} | Optional with capability signalling | |
| NTT DOCOMO, INC. [16] |  |

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| 58. NR\_AIML\_Air | 58-3-4 | UE side data collection for CSI prediction | 1. Support of data collection for CSI prediction | FFS | yes | n/a | UE side data collection for CSI prediction is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |

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| Company | Summary |
| Ericsson [2] |  |
| Nokia [3] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-4 | UE side data collection for CSI prediction | 1. Support of data collection for CSI prediction | FFS | yes | n/a | UE side data collection for CSI prediction is not supported | Per band and Per BC | N/A | N/A | N/A |  | Optional with capability signalling | |
| CATT/CICTCI [4] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-4 | UE side data collection for CSI prediction | 1. Support of data collection for CSI prediction | ~~FFS~~ | yes | n/a | UE side data collection for CSI prediction is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling | |
| Huawei/HiSilicon [5] |  |
| Vivo [6] |  |
| Xiaomi [7] |  |
| ZTE Corporation/Sanechips [8] |  |
| Samsung [9] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-3-3 | Data collection for AI/ML based CSI prediction for UE-sided model | 1. Support of data collection for AI/ML based CSI prediction  ~~2. Value for CPU occupation, when P/SP-CSI-RS is configured for CMR for data collection~~ | FFS | yes | n/a | Data collection for UE-side CSI prediction is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling | |
| Ofinno [10] |  |
| OPPO [11] |  |
| LG Electronics [12] |  |
| Apple [13] |  |
| CMCC [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] | The prerequisite of this FG can be FG2-35 since the training data collection is based on the legacy CSI framework and no AI/ML model is involved.  **Proposal 14: Update the FG58-3-4 as the following,**   * **Use FG 2-35 as the prerequisite (UEs without AI/ML capability can support the data collection).**  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-4 | UE side data collection for CSI prediction | 1. Support of data collection for CSI prediction | 2-35 | yes | n/a | UE side data collection for CSI prediction is not supported | Per UE | No | No |  |  | Optional with capability signalling | |

**Other**

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| Company | Summary |
| Ericsson [2] | 1. Support an additional FG for supporting performance monitoring for Rel-19 CSI prediction using UE-sided models. |
| Nokia [3] |  |
| CATT/CICTCI [4] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-3 | Performance monitoring for CSI prediction | 1. Support of UE assisted Type-3 performance monitoring | 58-3-1 | yes | n/a | UE assisted performance monitoring for CSI prediction is not supported | [Per band and Per BC] | FFS | FFS | FFS | FFS: CPU/AIMLPU related information | Optional with capability signalling | |
| Huawei/HiSilicon [5] |  |
| Vivo [6] |  |
| Xiaomi [7] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-3 | Aperiodic CSI report timing relaxation | Support of aperiodic CSI report time relaxation is equal to t + Z/Z’ | 58-3-1, 58-3-2 |  |  |  |  |  |  |  | The value of t could be equal to or , where , |  | | 58. NR\_AIML\_Air | 58-3-5 | Performance monitoring for CSI prediction model | 1. Performance metric SGCS   2. One wideband frequency gruanularity SGCS per layer  3. One monitoring resource set  4. One configured time instance for N4>1 | 58-3-1 |  |  |  |  |  |  |  |  |  | | 58. NR\_AIML\_Air | 58-3-6 | Data collection for UE-side CSI prediction | 1. Support periodic and semi-persistent CSI-RS resource   2. Number of CSI-RS resources | 58-3-1 |  |  |  |  |  |  |  |  |  | |
| ZTE Corporation/Sanechips [8] | The Rel-19 UE features for AI/ML use cases for air interfaces will be the first set of AI/ML UE features in 3GPP for physical layer. The related UE features should be carefully designed in order to facilitate the potential commercialization of AI/ML use cases for physical layer and establish a solid foundation for 6G discussion. Below we provide two general principles for designing the UE features for AI/ML use cases in physical layer.  **Principle#1:** **Balance between UE capability report and applicability report**  RAN2 has designed detailed procedure for applicability report for AI beam prediction and AI POS enhancement [1].   |  | | --- | | RAN2 further has made following agreements and signalling procedure (see the attached figure) on applicable functionality reporting for beam management UE-sided model:     * **Step 1**: Network sends *UECapabilityEnqiry* message to initiate the procedure to a UE reporting its AI/ML supported functionalities. * **Step 2**: UE sends *UECapablityInformation* message to network, containing supported functionalities at the UE side. * “**Step 3**”: Following configurations are provided from NW to UE:   1) UE is allowed to do UAI reporting via *OtherConfig*.  2) Network may provide NW-side additional condition. FFS on the RRC signalling and whether it is mandatory or optional.  3) FFS on configuration (e.g. inference configuration) of supported functionalities. FFS on the content of configuration.   * (**Between “Step 3” and “Step 4”**) UE decides the applicable functionalities based on NW-side additional conditions (if provided), UE-side additional conditions (internally known by UE) and model availability in device. FFS whether other configuration can considered by UE (e.g. inference configuration). FFS how the applicable functionality is decided if NW-side additional condition is not provided in step 3. * “**Step 4**”: UE reports applicable functionality in the following scenarios:   1) Upon being configured to provide applicable functionality and upon change of applicable functionality via UAI  2) As response to NW-side additional condition requesting applicable functionality reporting in step 3, FFS other network configuration (e.g. inference configuration).   * **Step 5**:   1) Network configures inference configuration to UE after applicable functionality reporting, if inference configuration based on supported functionality is not provided in Step 3 (i.e. inference configuration is provided in Step 5).  2) If inference configuration based on supported functionality is provided in Step 3, it is up to network implementation whether to provide an updated configuration or not. |   Basically, the UE feature report is more like static reporting, while the applicability report is more like semi-static reporting. On easier example to better understand the difference between UE feature report and applicability report is hardware capability and software capability, although it is not 100% accurate. UE feature report is more related to hardware capability, while applicability report is more related to software capability that may be subject to infrequent update.  Designing UE features for AI/ML use cases for physical layer should consider the balance between UE feature report and applicability report. If the design leans towards the UE capability reporting, it will result with UE capability with extreme finer granularity. If the design leans towards the applicability reporting, it will result with frequent applicability reporting.  **Principle#2: Balance between UE implementation flexibility and UE implementation fragmentation**  The UE feature design should always prioritize the balance between UE implementation flexibility and UE implementation fragmentation. Finer granularity of UE capability reporting leads to higher UE implementation flexibility at the cost of higher UE implementation fragmentation, which is not friendly for the network implementation and commercialization. Rel-19 will be the first release for AI/ML use cases for physical layer, it is essential to prioritize the balance between UE implementation flexibility and UE implementation fragmentation to set solid foundation for future commercialization.  ***Proposal 1****: Consider the following two principles for Rel-19 UE feature design for AI/ML use cases for physical layer*   * *Principle#1: Balance between UE capability report and applicability report* * *Principle#2: Balance between UE implementation flexibility and UE implementation fragmentation* |
| Samsung [9] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_air | 58-3-4 | Performance monitoring for AI/ML based CSI prediction for UE-sided model | 1. Support of performance monitoring for AI/ML based CSI prediction  2. Value for APU and CPU occupation, when P/SP-CSI-RS is configured for CMR for data collection  3. Support for SGCS reporting for baseline CSI | FFS | yes | n/a | Performance monitoring for UE-side CSI prediction is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling | |
| Ofinno [10] |  |
| OPPO [11] | Regarding the 58-3-4 FG of UE side data collection for CSI prediction:   * Add supported values of the maximum number of resources for measurement * Add supported values of the maximum number of future time instance  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Ai | 58-3-4 | UE side data collection for CSI prediction | 1. Support of data collection for CSI prediction  2. Supported values of the maximum number of resources for measurement  3. Supported values of the maximum number of future time instance. | 58-3-1/2 | yes | n/a | UE side data collection for CSI prediction is not supported | FFS | FFS | FFS | FFS | [Component 2 candidate values: {5,10,20}]  [Component 3 candidate values: {1,2,4,8}] | Optional with capability signalling | |
| LG Electronics [12] |  |
| Apple [13] |  |
| CMCC [14] | Besides, we have agreed to support performance monitoring for CSI prediction [3], we suggest introducing the corresponding Rel-19 UE FG for AI/ML based CSI prediction:   |  | | --- | | [120bis] Agreement  For CSI prediction using UE-side model, for performance monitoring, support UE assisted performance monitoring subject to an additional UE capability, and UE assisted performance monitoring is based on Type 3 performance monitoring |   ***Proposal 9: Introduce the following Rel-19 UE FG for AI/ML based CSI prediction:***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-14 | Performance monitoring for CSI prediction | 1. Support of Type 3 performance monitoring based on SGCS for CSI prediction | 58-3-1 | Yes | n/a | Type 3 performance monitoring based on SGCS for CSI prediction is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signaling | |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-1-8 | UE side monitoring for CSI prediction for UE sided inference | 1. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  2. support of reporting second SGCS for non-prediced CSI | 58-3-1 | yes | n/a | UE side monitoring for CSI prediction for UE sided inference is not supported | [Per band and Per BC] | n/a | n/a | n/a | Candidate values for component 1:  - Maximum 16 triplets  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256}  Candidate values for component 2: [supported, not supported] | Optional with capability signalling | |
| NTT DOCOMO, INC. [16] | Based on the agreements, an additional FG should be introduced for performance monitoring. To reflect the current progress, we propose the following FG,  **Proposal 15:Introduce the following FG for the performance monitoring of AI/ML CSI prediction.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 58. NR\_AIML\_Air | 58-3-5 | UE side performance monitoring for CSI prediction for UE-sided inference | Support the CSI report with reportQuantity set to csi-pai-r19 | 58-3-1 | yes | n/a | UE side performance monitoring for CSI prediction for UE-sided inference is not supported | Per band and Per BC | No | No |  |  | Optional with capability signalling | |

# Discussion Items during RAN1 #122

After review of contributions submitted to RAN1 #122 in this agenda item, the following topics were identified by the moderator for discussion during RAN1 #122.

**General comments**

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| --- | --- |
| Company | Comments/Questions/Suggestions |
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## Specification support for beam management

After review of contributions submitted to RAN1 #122 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. NR\_AIML\_air | 58-0-1 | CSI report framework ~~for UE-side inference~~ | 1. Number of APU pools N  ~~1~~2. Maximum number of APUs in each APU pool ~~for all types of UE-sided inference~~ for CSI report(s) for simultaneously in a CC  ~~2~~3. Maximum number of APUs in each APU pool ~~for all types of UE-sided inference~~ for CSI report(s) simultaneously across all CCs | FFS | yes | n/a | Maximum number of APUs ~~for UE-sided inference~~ is unknown to the network | ~~FFS~~ Per UE | ~~FFS~~ N/A | ~~FFS~~ N/A | ~~FFS~~ N/A | Component 1 candidate values: {1,2}  Component 1 candidate values: ~~FFS~~{1…8}  Component 2 candidate values: ~~FFS~~{1…32} | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | Support Mod’s proposal. We suggest 2-35 as the prerequisite for this FG. Then, the BM and CSI prediction features for inference result reporting can use it as a prerequisite. |

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_air | 58-1-1 | Increased number of reported RSs for beam management | 1. Support of reporting format for L1-RSRP measurements not including CRI/SSBRI other than one for the largest measured L1-RSRP in a reporting instance, if the number of reported L1-RSRPs is equal to the size of the measurement resource set.  2. Support of reporting format for L1-RSRPs and corresponding beam information of Top M beam(s) with largest M measured value(s) of L1-RSRP(s) of a measurement resource set, where M is configured by gNB, if the number of reported L1-RSRPs is smaller than the size of the measurement resource set  3. Maximum number of M reported RSs, M>4 | FFS | yes | n/a | Increased number of reported beams for beam management is not supported | ~~FFS~~ Per UE | ~~FFS~~ N/A | ~~FFS~~ N/A | ~~FFS~~ N/A | Component 3 candidate values: {6,8} | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | Support Mod’s proposal. We suggest 2-24 as the prerequisite. |

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_air | 58-1-2 | UE-side beam prediction for BM Case1 ~~[~~for inference~~]~~ | 1. Support of beam prediction with reporting of predicted beam index for BM-Case1 ~~[~~for inference~~]~~ with UE-side model  3. Maximum number of inference report(s) configured for BM-Case1 per BWP  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  ~~[4. Maximum number of inference report(s) activated for BM-Case1 per BWP]~~  ~~[4a. Maximum number of inference report(s) activated for BM-Case1 across all CCs]~~  ~~[5. Maximum number of inference report(s) triggered for BM-Case1 per BWP]~~  ~~[5a. Maximum number of inference report(s) triggered for BM-Case1 across all CCs]~~  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[7. Supported combinations of the number of resources for Set B and the number of resources for Set A]~~  ~~[7a: Supported maximum number of resources for Set B]~~  ~~[7b: Supported maximum number of resources for Set A]~~  ~~[~~8. Supported CSI-RS resource types: Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS~~]~~  ~~[~~9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report~~]~~  ~~[10. Supported options for performance monitoring for beam case 1 with UE side model]~~  ~~[~~11. Supported BM-Case 1 sub-usecase(s): {setB-subset-of-setA, setB-different-from-setA, both}  12. Supported maximum number of predicted beams in each reporting instanceFFS: whether/how to merge this FG with other FG(s) for performance monitoring and/or data collection  13. Supported number of occupied CPU if *nroftimeinstance-r19* is not configured  14. Supported number of occupied APU if *nroftimeinstance-r19* is not configured  15. Supported value of d for the relaxation of Z3 timeline if *nroftimeinstance-r19* is not configured  16. Supported value of d’ for the relaxation of Z’3 timeline if *nroftimeinstance-r19* is not configured | FFS | yes | n/a | UE-side~~d~~ beam prediction for BM Case 1 ~~[~~for inference~~]~~ is not supported | FFS | FFS | FFS | FFS | FFS: CPU/AIMLPU related information | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | For components 13 and 14, we suggest limiting the number of candidate values, e.g., two candidate values besides 0. For example, if the maximum N\_APU is 8, the candidate values for component 14 can be {0, 2, 4}.  For supporting 2 APU pools, one additional component is necessary “Index about which APU resource pool is CPU\_2.”  The prerequisite of this FG includes 2-24 and 58-0-1. |

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_air | 58-1-3 | UE-side beam prediction for BM Case1 with predicted RSRP ~~[~~for inference~~]~~ | 1. Support of beam prediction, reporting of predicted beam index and predicted RSRP, for BM-Case1 ~~[~~for inference~~]~~  2. Supported maximum number of predicted beams with RSRP in each reporting instance  3. The number of additional symbols, di, between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing predicted beam report, where i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS  4. The number of additional symbols, di’, between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing predicted beam, where i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS | 58-1-2 | yes | n/a | UE-side beam prediction for BM Case 1 with predicted RSRP ~~[~~for inference~~]~~ is not supported | FFS | FFS | FFS | FFS | Component 2 candidate values: {1, 2, 3, 4}  FFS: CPU/AIMLPU related information | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | We believe there is no need to address the CPU/APU issue since 58-1-2 is the prerequisite. So the FFS part in candidate values can be removed. |

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 ~~[~~for inference~~]~~ | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 ~~[~~for inference~~]~~ with UE-side model  3. Maximum number of inference report(s) configured for BM-Case2 per BWP  3a. Maximum number of inference report(s) configured for BM-Case2 across all CCs  ~~[4. Maximum number of inference report(s) activated for BM-Case2 per BWP]~~  ~~[4a. Maximum number of inference report(s) activated for BM-Case2 across all CCs]~~  ~~[5. Maximum number of inference report(s) triggered for BM-Case2 per BWP]~~  ~~[5a. Maximum number of inference report(s) triggered for BM-Case2 across all CCs]~~  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  ~~[7. Supported combinations of the number of resources for Set B and the number of resources for Set A]~~  ~~[7a: Supported maximum number of resources for Set B]~~  ~~[7b: Supported maximum number of resources for Set A]~~  ~~[8. Supported CSI-RS resource types: Periodic CSI-RS, Semi-persistent CSI-RS]~~  ~~[~~9. Supported inference report types: Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report~~]~~  ~~[10. Supported options for performance monitoring for beam case 2 with UE side model]~~  11. Supported maximum number of predicted beams in each predicted time instance  12. Supported maximum number of predicted time instances  ~~[~~13. Supported maximum total number of reported predicted beams for predicted time instances in one report~~]~~  14. Supported combinations of supported value(s) of valid time duration for each predicted time instance and number of predicted beams for each value of valid time duration  ~~[20. Supported BM-Case 2 sub usecase(s): e.g., setB-equals-to-setA, setB-subset-of-setA, setB-different-from-setA, or merged version(s)]~~  21. supported number of occupied CPU if *nroftimeinstance-r19* is configured  22. supported number of occupied APU if *nroftimeinstance-r19* is configured  23. supported value of d for the relaxation of Z3 timeline if *nroftimeinstance-r19* is configured  24. supported value of d’ for the relaxation of Z’3 timeline if *nroftimeinstance-r19* is configured | FFS | yes | n/a | UE-side beam prediction for BM-Case2 ~~[~~for inference~~]~~ is not supported | FFS | FFS | FFS | FFS | FFS: CPU/AIMLPU related information  FFS: candidate values for components | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | Generally, we have the same proposal as 58-1-2:  For components 21 and 22, we suggest limiting the number of candidate values, e.g., two candidate values besides 0. For example, if the maximum N\_APU is 8, the candidate values for component 14 can be {0, 2, 4}.  For supporting 2 APU pools, one additional component is necessary “Index about which APU resource pool is CPU\_2.”  The prerequisite of this FG includes 2-24 and 58-0-1. |

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. NR\_AIML\_air | 58-1-5 | UE-side beam prediction for BM-Case2 with predicted RSRP ~~[~~for inference~~]~~ | 1. Support of beam prediction, reporting of predicted beams and predicted RSRP, for BM-Case2 (spatial and time domain beam prediction) ~~[~~for inference~~]~~  2. Supported maximum number of predicted beams with RSRP in each predicted time instance  3. Supported maximum total number of predicted beams with RSRP for predicted time instances in one report  4. Supported maximum number of predicted time instances  5. Supported value(s) of time gap between predicted time instances  6. The number of additional symbols, di, between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing predicted beam report, where i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS  7. The number of additional symbols, di’, between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing predicted beam, where i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS | 58-1-4 | yes | n/a | UE-side beam prediction for BM-Case2 ~~[~~for inference~~]~~ is not supported | FFS | FFS | FFS | FFS | FFS: CPU/AIMLPU related information | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | The similar proposal from 58-1-3:  We believe there is no need to address the CPU/APU issue since 58-1-4 is the prerequisite. So the FFS part in candidate values can be removed. |

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. NR\_AIML\_air | 58-1-7 | Data collection for UE-side beam prediction ~~[for BM case 1]~~ | 1. Support of data collection for UE-side beam prediction ~~[for BM case 1]~~  2. Support of SS/PBCH block and 1-port CSI-RS based RSRP measurements for measurement RS resource sets (Set B and Set A) for data collection  ~~[~~3. Supported sub-use cases~~: {‘Set B equal to Set A’, ‘Set B subset of Set A’,’Set B not a subset of Set A’}]~~  ~~[~~6: Supported maximum number of resources for Set B~~]~~  ~~[~~7: Supported maximum number of resources for Set A~~]~~  8. Support of SSB as RS type for Set B  9. Support of CSI-RS as RS type for Set B  10. Support of SSB as RS type for Set A  11. Support of CSI-RS as RS type for Set A | FFS | yes | n/a | Data collection for UE-side beam prediction is not supported ~~[for BM case 1]~~ | FFS | FFS | FFS | FFS | Component 3 candidate values: {‘Set B equal to Set A’, ‘Set B subset of Set A’,’Set B not a subset of Set A’}  Component 6 candidate values: {4, 8, 16, 32, 64}  Component 7 candidate values: {8, 16, 32, 48,  Note: it is up to RAN2 whether this FG is merged into data collection FG defined by RAN2 | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | Suggest 2-24 as the prerequisite since this feature does not require AI/ML.  The granularity is Per UE.  We are fine with the proposed revisions. |

**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. NR\_AIML\_air | 58-1-6 | Performance monitoring for UE-sided model | 1. Support of performance monitoring with RS-PAI of AI/ML model for beam prediction.  2. Maximum total number of the configured CSI-RS resources for monitoring RS resource set  3. Maximum number of periodic CSI report setting per BWP for monitoring reporting  4. Maximum number of aperiodic CSI report setting per BWP for monitoring reporting  5. Maximum number of semi-persistent CSI report setting per BWP for monitoring reporting  6. Supported values of configured transmission occasion N  7. Supported sub usecase of monitoring RS resource set C: { setC-equals-to-setA, setC-subset-of-setA, both}  8.Supported periodicity of performance monitoring report | 58-1-2,58-1-3,58-1-4, or 58-1-5 | yes | n/a | Performance monitoring for UE-sided model is not supported | FFS | FFS | FFS | FFS | FFS: Further partitioning of this FG based on existing and future agreements  FFS: separate rows/FGs for case 1 and case 2 | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| NTT DOCONO | For the prerequisite, only 58-1-2 and 58-1-4 are necessary. |

**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. NR\_AIML\_air | 58-1-8 | Consistency between model training and inference | 1.Supported maximum number of associated IDs | FFS | yes | n/a | Consistency between model training and inference is not supported | FFS | FFS | FFS | n/a |  | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | Support. |

**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_air | 58-1-9 | APU for AI/ML based processing | 1.Supported number of APU pools for AI based processing  2. Supported maximum number of APUs for each APU pool. | FFS | yes | n/a | APU for AI/ML based processing is not supported | FFS | FFS | FFS | n/a | candidate values for Component 1: {1, 2} | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | This one is not needed, given that FG 58-0-1 is updated with the corresponding contents. |

## Specification support for positioning accuracy enhancement

After review of contributions submitted to RAN1 #122 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-2-1 | UE-based positioning Case 1 ~~[~~for inference~~]~~ | 1. ~~Indicates~~ Support of UE-based positioning Case 1 ~~[~~for inference~~]~~  2. Support LMF initiated activation / deactivation of UE-based positioning Case 1  3. Support reporting the location estimate as generated by UE-based positioning Case 1 | ~~FFS~~  13-1 | N/A | N/A | UE-based positioning Case 1 ~~[~~for inference~~]~~ is not supported | ~~FFS~~  Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | * The 2 And 3 in the description are not needed. Do not include “for inference”. * Update the prerequisite to 58-2-4. * Support “per UE”. |

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-2-2 | Support reception of AD for UE-based positioning Case 1 | Indicates support of reception of AD for UE-based positioning Case 1 | ~~FFS~~ 58-2-1 | N/A | N/A | Reception of AD for UE-based positioning Case 1 is not supported | Per UE | n/a | n/a | n/a | Need for location server to know if the feature is supported.  Note: For specific ADs, UE indicate supported AD that can be received as in [FFS: FGs] | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-2-3 | DL PRS Resources for UE-based positioning Case 1 | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE  2. Max number of TRPs across all positioning frequency layers per UE  3. Max number of positioning frequency layers UE supports | ~~[~~13-1~~]~~ | N/A | N/A |  | Per UE | No | No | No | Component 1 candidate values: {1, 2}  Component 2 candidate values: {4, 6, 12, 16, 24, 32, 64, 128, 256}  Component 3 candidate values: {1, 2, 3, 4}  Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | Update prerequisite to 58-2-4 |

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-2-3a | DL PRS Resources for UE-based positioning Case 1 on a band | [1. Max number of DL PRS Resources per DL PRS Resource Set  2. Max number of DL PRS Resources per positioning frequency layer | ~~[~~13-1~~]~~ | N/A | N/A |  | Per band | n/a | n/a | n/a | Component 1 candidate values: {1, 2, 4, 8, 16, 32, 64}  Component 2 candidate values: {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: For component 1, the values 16, 32, 64 are only applicable to FR2 bands  Note: For component 2, the value 6 is only applicable to FR1 bands  Need for location server to know if the feature is supported.  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | Update prerequisite to 58-2-4 |

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-2-3b | DL PRS Resources for UE-based positioning Case 1 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  2. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only  3. 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  4. 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 | ~~[~~13-1~~]~~ | N/A | N/A |  | Per BC | n/a | n/a | n/a | Component 1 candidate values: {6, 24, 64, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR1 only BC  Component 2 candidate values: {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC  Component 3 candidate values: {6, 24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands  Component 4 candidate values: {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands]  Need for location server to know if the feature is supported.  Note: the reported value is the total number across all bands in the corresponding BC  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | Update prerequisite to 58-2-4 |

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-2-4 | DL PRS Processing Capability for UE-based positioning Case 1 | 1. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE.  2. DL PRS buffering capability: Type 1 or Type 2  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering  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, which is supported and reported by UE.  4. Max number of DL PRS resources that UE can process in a slot under it  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%. | ~~FFS~~ | No | N/A |  | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  Component 1 candidate values:  -FR1 bands values {5, 10, 20, 40, 50, 80, 100}  -FR2 bands values {50, 100, 200, 400}  Component 3 candidate values:  -T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  -N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Component 4 candidate values:  -FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  -FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  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  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support PRS processing in this band or band combination.  ~~[~~Note: If the UE reports both FG 13-1 and ~~[~~this FG~~]~~, then the UE is not expected to perform simultaneous processing of legacy methods and Case 1 positioning method.  Note: If UE does not provide ~~[~~this FG~~]~~ but the UE supports Case 1, FG 13-1 indicates the DL PRS processing capabilities common across all positioning methods including UE-based positioning Case 1.~~]~~ | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | * No prerequisite is required for this FG as this is the baseline FG for Case 1. Delete 13-1 * The note listing should be updated:   + The first original note should be deleted because there are additional FGs intended to describe whether UE supports simultaneous Case 1 and other methods   + The second original note also need to be deleted and replaced by the last one. The last one gives better description and carries same intention as in the one to be deleted.   + Keep only “Note: if UE supports same values for one or more components as in FG 13-1, then the UE can skip indicating these components in this FG and the values in corresponding FG 13-1 components indicate supported PRS processing capabilities for Case 1“ |

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-2-5 | Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of SSB from neighbour 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 | ~~[~~58-2-4; otherwise 13-1~~]~~ | No | N/A | SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | Delete “otherwise 13-1” |

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-2-6 | Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS  Note 1: Refers to Type-D support for FR2  Note 2: A PRS from a PRS-only TP is treated as PRS from a non-serving cell | ~~[~~58-2-4; otherwise 13-1~~]~~ | No | N/A | DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Note: if UE supports same values for one or more components as in FG 13-7a, then the UE can skip indicating these components in this FG and the values in corresponding FG 13-7a components indicate supported QCL sources for Case 1  Need for location server to know if the feature is supported.  DL PRSs are in the same band | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | Delete “otherwise 13-1” |

**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-7 | Support of PRS measurement in RRC\_INACTIVE state for case 1 | Support of PRS measurement in RRC\_INACTIVE state for case 1 - location server | 58-2-3, 27-6 | No |  | PRS measurement in RRC\_INACTIVE state for case 1 is not supported | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  Note: PRS capabilities for case 1 described in FGs in 58-2-3, 58-2-3a, 58-2-3b are the same for RRC Inactive.  Support of PRS processing measurement in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signaling |

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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-7 | Simultaneous UE-based positioning Case 1 and DL-TDoA positioning | 1. Support of simultaneous operation for UE-based positioning Case 1 and DL TDoA | 58-2-3 and 13-3 | No | N/A |  | Per band | n/a | n/a | n/a | If it is not indicated, a UE is not expected to perform simultaneously the UE-based positioning Case 1 and DL TDoA positioning  Need for location server to know if the feature is supported. | Optional with capability signaling |

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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-8 | Simultaneous UE-based positioning Case 1 and DL-AoD positioning | 1. Support of simultaneous operation for UE-based positioning Case 1 and DL AoD | 58-2-3 and 13-2 | No | N/A | Simultaneous UE-based positioning Case 1 and DL-AoD positioning is not supported | Per band | n/a | n/a | n/a | If it is not indicated, a UE is not expected to perform simultaneously the UE-based Case 1 and DL AoD positioning  Need for location server to know if the feature is supported. | Optional with capability signaling |

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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-9 | DL PRS measurement outside MG and in a PRS processing window for UE-based positioning Case 1 | 1. Supported PRS processing types subject to the UE determining that DL PRS to be higher priority for PRS measurement outside MG and in a PRS processing window  2. Support of priority handing options of PRS: Option1, Option2 or Option3  − Option 1: Support of "st1" and "st3" defined in clause 5.1.6.5 of TS 38.214 [20]  − Option 2: Support of "st1", "st2", and "st3" defined in clause 5.1.6.5 of TS 38.214 [20]  - Option 3: Support of "st1" only defined in clause 5.1.6.5 of TS 38.214 [20] | [58-2-4] | N/A | N/A | DL PRS measurement outside MG and in a PRS processing window for UE-based positioning Case 1 is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: One or more of {Type 1A, Type 1B, Type 2}  Component 2 candidate values: {option1, option2, option3}  Need for location server to know if the feature is supported  Note: Component 2 can be reported per supported band for each type supported by the UE, details left to RAN2  Note:  - Type 1A refers to the determination of prioritization between DL PRS and other DL signals/channels in all OFDM symbols within the PRS processing window. The DL signals/channels from all DL CCs (per UE) are affected across LTE and NR  - Type 1B refers to the determination of prioritization between DL PRS and other DL signals/channels in all OFDM symbols within the PRS processing window. The DL signals/channels from a certain band are affected  - Type 2 refers to the determination of prioritization between DL PRS and other DL signals/channels only in DL PRS symbols within the PRS processing window  Note: When the UE determines higher priority for other DL signals/channels over the PRS measurement/processing, the UE is not expected to measure/process DL PRS which is applicable to all of the above capability options  Note: Within a PRS processing window, UE measurement is inside the active DL BWP with PRS having the same numerology as the active DL BWP  Note: Support of configuration of PRS processing window in RRC and support of using DL MAC CE to activate/deactivate the PRS processing window for PRS measurements is part of the FG , but no dedicated signaling is required.  A UE that supports [FG 58-2-10] must indicate this FG is supported | Optional with capability signalling |

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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-10 | DL PRS Processing Capability outside MG - buffering capability for UE-based positioning Case 1 | 1. DL PRS buffering capability  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering  2a. 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  2b. Duration of DL PRS symbols N2 in units of ms a UE can process inT2 ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE  3. Max number of DL PRS resources that UE can process in a slot  4. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE for PRS measurement outside MG within the PPW | [58-2-9] | N/A | N/A | DL PRS Processing Capability outside MG - buffering capability for UE-based positioning Case 1 is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {Type 1, Type 2}  Component 2a candidate values:  a) T: {1, 2, 4, 8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  b) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Candidate 2b component values:  a) N2: {0.125, 0.25, 0.5, 1, 2, 3, 4, 5, 6, 8, 12} ms  b) T2: {4, 5, 6, 8} ms  Component 3 candidate values:  FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Component 4 candidate values:  FR1 bands: {5, 10, 20, 40, 50, 80, 100}  FR2 bands: {50, 100, 200, 400}  Need for location server to know if the feature is supported  Note 1:The (N, T) UE capabilities are interpreted as legacy (N, T) in [FG 58-2-4], and the UE is expected to receive the PRS within the PRS processing window and but the processing of the received PRS may be outside a PRS processing window.  The (N2, T2) UE capabilities are interpreted such that the UE is capable of measuring up to N2 ms PRS within a PPW and is capable of completing the PRS processing within the PPW, e.g., if the time duration from the last symbol of the measured PRS resource(s) inside the PPW, to the end of PPW is not smaller than T2 ms  Note 3: UE shall support either component 2a and component 2b , but not both for each supported type in a band  Note 4: A UE shall declare PRS processing capabilities of each of the supported Type-1A, Type-1B, Type-2 capabilities in case it supports multiple types in a band  A UE that supports [FG 58-2-9] must indicate this FG is supported  Note: if UE supports same values for one or more components as in FG 27-3-3, then the UE can skip indicating these components in this FG and the values in corresponding FG 27-3-3 components indicate supported PRS processing capabilities outside MG for Case 1 | Optional with capability signalling |

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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-11 | Support of more than one activated PRS processing windows across all active DL BWPs for UE-based positioning Case 1 | 1. Number of supported activated PRS processing windows | [58-2-9] | N/A | N/A | DL PRS measurement outside MG and in a PRS processing window for UE-based positioning Case 1 is not supported | Per UE | No | No | No | Candidate values: {2, 3, 4} | Optional with capability signalling |

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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-12 | Support of UE-based positioning Case 1 in RRC\_INACTIVE state | UE-based positioning Case 1 in RRC\_INACTIVE state is supported | [58-2-3 and 58-2-13~~]~~ | N/A | N/A | UE-based positioning Case 1 in RRC\_INACTIVE state is not supported | Per Band | n/a | n/a | n/a | Support of UE-based positioning Case 1 in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signalling |

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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-13 | DL PRS processing capabilities in RRC inactive state for UE-based positioning Case 1 | 1. DL PRS buffering capability  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering  2. 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  3. Max number of DL PRS resources that UE can process in a slot | [58-2-4] | N/A | N/A |  | Per band | n/a | n/a | n/a | Component 1 candidate values: {Type 1, Type 2}  Component 2 candidate values:  T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Component 3 candidate values:  FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Need for location server to know if the feature is supported  Note: Having the PRS processing capabilities in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state  Note: if UE supports same values for one or more components as in FG 27-6, then the UE can skip indicating these components in this FG and the values in corresponding FG 27-6 components indicate supported PRS processing capabilities in RRC inactive state for Case 1 | Optional with capability signalling |

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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-14 | Support of UE-based positioning Case 1 in RRC\_IDLE | Support of UE-based positioning Case 1 in RRC\_IDLE | [ 58-2-4,  58-2-12,  58-2-13] | N/A | N/A | UE-based positioning Case 1 in RRC\_IDLE  is not supported | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported | Optional with capability signalling |

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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-15 | DL PRS processing capabilities for aggregated PRS processing of 2 PFLs in intra-band contiguous within a MG for RRC\_CONNECTED - UE-based positioning Case 1 | 1. Maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE  2. Maximum DL PRS bandwidth in MHz, per PFL  3. DL PRS buffering capability  4. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE.  5. Maximum number of aggregated DL PRS resources across aggregated PFLs that UE can process in a slot | [58-2-4] | N/A | N/A | DL PRS processing capabilities for aggregated PRS processing of 2 PFLs in intra-band contiguous within a MG for RRC\_CONNECTED - UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Component 1 candidate values:  a) FR1 bands: {10, 20, 40, 50, 80, 100, 160, 200}  b) FR2 bands: {100, 200, 400, 800}  Component 2 candidate values:  a) FR1 bands: {5, 10, 20, 40, 50, 80, 100}  b) FR2 bands: {50, 100, 200, 400}  Note: Component 3 in this FG follows buffering capability type reported in [FG 58-2-4]  Component 4 candidate values:  a) T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  b) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Note: this value N should be equal or smaller than the value N reported by [FG 58-2-4], or this value T should be equal or larger than the value T reported by [FG 58-2-4]  Component 5 candidate values:  a. FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  b. FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Note: each two linked PRS resources are counted as 1 resource  Note: this value should be equal or smaller than the value reported by [FG 58-2-4]  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%  Note: if UE supports same values for one or more components as in FG 41-4-1, then the UE can skip indicating these components in this FG and the values in corresponding FG 41-4-1 components indicate supported aggregated PRS processing of 2 PFLs in intra-band contiguous within a MG for RRC\_CONNECTED for Case 1 | Optional with capability signalling |

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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-15a | DL PRS processing capabilities for aggregated PRS processing of 3 PFLs in intra-band contiguous within a MG for RRC\_CONNECTED - UE-based positioning Case 1 | 1. Maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE  2. Maximum DL PRS bandwidth in MHz, per PFL  3. DL PRS buffering capability  4. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE.  5. Maximum number of aggregated DL PRS resources across aggregated PFLs that UE can process in a slot | [58-2-15] | N/A | N/A | DL PRS processing capabilities for aggregated PRS processing of 3 PFLs in intra-band contiguous within a MG for RRC\_CONNECTED - UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Component 1 candidate values:  a) FR1 bands: {15, 20, 30, 40, 50, 60, 80, 100, 120, 140, 150, 160, 180, 200, 240, 300}}  b) FR2 bands: {150, 200, 300, 400, 600, 800, 1000, 1200}  Component 2 candidate values:  a) FR1 bands: {5, 10, 20, 40, 50, 80, 100}  b) FR2 bands: {50, 100, 200, 400}  Note: Component 3 in [FG58-2-15a (this FG)] follows buffering capability type reported in [FG 58-2-4]  Component 4 candidate values:  a) T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  b) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Note: this value N should be equal or smaller than the value N reported by [FG 58-2-4] or this value T should be equal or larger than the value T reported by [FG 58-2-4]  Component 5 candidate values:  a. FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  b. FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Note: each three linked PRS resources are counted as 1 resource  Note: this value should be equal or smaller than the value reported by [FG 58-2-4]  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%  Note: if UE supports same values for one or more components as in FG 41-4-1a, then the UE can skip indicating these components in this FG and the values in corresponding FG 41-4-1a components indicate supported aggregated PRS processing of 3 PFLs in intra-band contiguous within a MG for RRC\_CONNECTED for Case 1 | Optional with capability signalling |

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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-15b | DL PRS processing capabilities for aggregated PRS processing of 2 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE - UE-based positioning Case 1 | 1. Maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE  2. Maximum DL PRS bandwidth in MHz, per PFL  3. DL PRS buffering capability  4. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE.  5. Maximum number of aggregated DL PRS resources across aggregated PFLs that UE can process in a slot | [58-2-13] | N/A | N/A | DL PRS processing capabilities for aggregated PRS processing of 2 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE - UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Component 1 candidate values:  a) FR1 bands: {10, 20, 40, 50, 80, 100, 160, 200}  b) FR2 bands: {100, 200, 400, 800}  Component 2 candidate values:a) FR1 bands: {5, 10, 20, 40, 50, 80, 100}  b) FR2 bands: {50, 100, 200, 400}  Note: Component 3 in [FG 58-2-15b (this FG)] follows buffering capability type reported in [FG 58-2-4]  Component 4 candidate values:  a) T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  b) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Note: this value N should be equal or smaller than the value N reported by [FG 58-2-13] or this value T should be equal or larger than the value T reported by [FG 58-2-13]  Component 5 candidate values:  a. FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  b. FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Note: each two linked PRS resources are counted as 1 resource  Note: this value should be equal or smaller than the value reported by [FG 58-2-13]  Note: if UE supports same values for one or more components as in FG 41-4-1b, then the UE can skip indicating these components in this FG and the values in corresponding FG 41-4-1b components indicate supported for aggregated PRS processing of 2 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE capabilities for Case 1 | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-15c | DL PRS processing capabilities for aggregated PRS processing of 3 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE - UE-based positioning Case 1 | 1. Maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE  2. Maximum DL PRS bandwidth in MHz, per PFL  3. DL PRS buffering capability  4. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum aggregated DL PRS bandwidth in MHz, which is supported and reported by UE.  5. Max number of aggregated DL PRS resources across aggregated PFLs that UE can process in a slot under it | [58-2-15b] | N/A | N/A | DL PRS processing capabilities for aggregated PRS processing of 3 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE - UE-based positioning Case 1 is not suported | Per Band | n/a | n/a | n/a | Component 1 candidate values:  a) FR1 bands: {15, 20, 30, 40, 50, 60, 80, 100, 120, 140, 150, 160, 180, 200, 240, 300}  b) FR2 bands: {150, 200, 300, 400, 600, 800, 1000, 1200}  Component 2 candidate values:  a) FR1 bands: {5, 10, 20, 40, 50, 80, 100}  b) FR2 bands: {50, 100, 200, 400}  Note: Component 3 in [FG 58-2-15c (this FG)~~]~~ follows buffering capability type reported in [FG 58-2-4]  Component 4 candidate values:  a) T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  b) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Note: this value N should be equal or smaller than the value N reported by [FG 58-2-13] or this value T should be equal or larger than the value T reported by [FG 58-2-13]  Component 5 candidate values:  a. FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  b. FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Note: each three linked PRS resources are counted as 1 resource  Note: this value should be equal or smaller than the value reported by [FG 58-2-13]  Note: if UE supports same values for one or more components as in FG 41-4-1c, then the UE can skip indicating these components in this FG and the values in corresponding FG 41-4-1c components indicate supported aggregated PRS processing of 3 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE for Case 1 | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-16 | PRS bandwidth aggregation with two PFL combinations - UE-based positioning Case 1 | Support of PRS bandwidth aggregation with two PFL combinations for UE-based positioning Case 1 | [58-2-15] | N/A | N/A | PRS bandwidth aggregation with two PFL combinations for UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  Note: More than one combination are measured in TDMed manner | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-17 | PRS bandwidth aggregation in RRC\_CONNECTED UE-based positioning Case 1 | Support of PRS bandwidth aggregation in RRC\_CONNECTED for UE-based positioning Case 1 | [58-2-3, 58-2-15] | N/A | N/A | PRS bandwidth aggregation in RRC\_CONNECTED for UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-18 | PRS bandwidth aggregation in RRC\_ INACTIVE UE-based positioning Case 1 | Support of PRS bandwidth aggregation in RRC\_ INACTIVE for UE-based positioning Case 1 | [58-2-12, 58-2-15b] | N/A | N/A | PRS bandwidth aggregation in RRC\_ INACTIVE for UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-19 | PRS bandwidth aggregation in RRC\_IDLE - UE-based positioning Case 1 | Support of PRS bandwidth aggregation in RRC\_IDLE for UE-based positioning Case 1 | [58-2-14, 58-2-15b] | N/A | N/A | PRS bandwidth aggregation in RRC\_IDLE  for UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-2-20 | Support of PRS TEG association information for UE-based positioning Case 1 | Support of reception of association between PRS and TRP Tx TEG for UE-based positioning Case 1 | [58-2-4] | N/A | N/A | Reception of PRS TEG association information for UE-based positioning Case 1 is not supported | Per UE | No | No | No | Need for location server to know if the feature is supported. | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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## Specification support for CSI prediction

After review of contributions submitted to RAN1 #122 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-3-1 | CSI prediction for UE-sided inference when N4=1 | 1. Support of CSI prediction for UE-sided inference when N4=1  2. Support for reporting predicted PMI with N4=1  3. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  5. Support parameter combinations with L=2,4  6. Support for rank = 1,2  7. Support for the size of DD-basis, N4=1  8. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  ~~[~~9. Value for CPU occupation, when P/SP-CSI-RS is configured for CMR~~]~~  ~~[~~10. Value for CPU occupation, when A-CSI-RS is configured for CMR~~]~~  11. Scaling factor for active resource counting Kp  12. Supported values of the maximum number of observation number  13. The number of additional symbols, t\_i, between the last symbol of CSI-RS and the first symbol of the transmission channel containing predicted CSI report, where i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS  14. The number of additional symbols, t\_i’, between the last symbol of CSI-RS and the first symbol of the transmission channel containing predicted CSI report, where  i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS | 2-35 | yes | n/a | CSI prediction for N4=1 for inference is not supported | ~~[~~Per band and Per BC~~]~~ | n/a | n/a | n/a | Component 3 candidate values:  a. {4,8,12,16,24,32}  b. {2,3,4 … 64}  c. {4, …, 256}  Compontent 9 candidate values when P/SP-CSI-RS is configured for CMR:  O\_CPU=M, M∈{0,1,2,3,4}  O\_APU=N, N∈{0,1,2,3,4}  Compontent 10 candidate values:  - when A-CSI-RS is configured for CMR and K<12, where where K is the number of A-CSI-RS resources  O\_CPU=M=Y\_1 K, Y\_1∈{0,1,2,3}  O\_APU=N=X\_1 K,  X\_1∈{0,1,2,3}  - when K=12  O\_CPU=M, M={0…8}  O\_APU=N, N={0…8} | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | 1. Suggest changing the 2-35 to 58-0-1 as the prerequisite to support the APU.  2. For component 9 and 10, we have the similar comments as BM: limiting the number of candidate values, e.g., two candidate values besides 0. For example, if the maximum N\_APU is 8, the candidate values for component 14 can be {0, 2, 4}.  3. For supporting 2 APU pools, one additional component is necessary “Index about which APU resource pool is CPU\_2.” |
| Ericsson | * + - 1. We share a similar view as Huawei that Supported values of the maximum number of observation number is not needed, as in legacy. A similar FG as 40-3-2-1b for Rel-18 CSI prediction can be defined for the same purpose as in legacy when AP CSI-RS is used. For P and SP CSI-RS, the number of observation is up to UE implementation. Component 12 shall be removed.       2. The following agreement supports a single t value will be added on top of Z/Z’, hence component 14 on t’ shall be removed.   Agreement  For CSI prediction using UE-side model, for inference, in addition to legacy Z/Z’ for doppler codebook, UE may report the value of t per SCS   * Detailed value of t can be discussed in UE feature   + - 1. On component 13, Z and Z’ are well-defined in specification, we should follow the original agreement, .e.g, with Samsung’s suggestion: 13. supported value of t for the relaxation of Zand Z’ timeline. We don’t think the current formulation correctly reflects the agreement. |
| Qualcomm | Component 9 and 10 should be replaced by O\_CPU value and O\_APU value. |

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-3-1-7 | Active CSI-RS resources and ports for mixed R16 based doppler codebook for CSI prediction via UE side model with other codebooks in any slot | 1. List of codebook combinations of two types  2. List of {max number of ports per resource, max number of resources, max number of total ports} for each codebook combination | 23-9-1, 16-3a, 2-36, 2-40, 2-41, 23-9-2, 23-9-4, 40-3-2-1, 40-3-2-1a, 40-3-2-2, X-1-1, X-1-1a, X-1-2 | Yes | n/a | Active CSI-RS resources and ports for mixed R16 based doppler codebook for CSI prediction via UE side model with other codebooks in any slot is not supported | Per band and Per BC | n/a | n/a | n/a | Component 1 candidate values: ~~FFS~~  {Type I SP, CSI prediction for UE-sided inference when N4=1 and R=1}  {Type I SP, CSI prediction for UE-sided inference when N4>1 and R=1}  {eType II R=1, CSI prediction for UE-sided inference when N4=1 and R=1}  {eType II R=1, CSI prediction for UE-sided inference when N4>1 and R=1}  Component 2 candidate values: ~~FFS~~  - Maximum 16 triplets  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256}  Note: if a UE reports one or more codebook combinations in 58-3-1-7, then usage of active CSI-RS resources and ports for multiple codebooks in any slot is allowed only within those combinations  Note: For coexisting of mixed codebooks in any slot, gNB need to honor 16-8, 23-9-5, 58-3-1-7 and per-codebook capability 2-36/40/41, 16-3a, and 23-9-1/23-9-2/23-9-4.  ~~[Note: Up to 4 combinations for component 1]~~ | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-3-2 | CSI prediction for UE-sided inference when N4>1 | 1. Support of CSI prediction for UE-sided inference when N4>1  2. Support for reporting predicted PMI with N4>1  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR  5. Support for the size of DD-basis, N4>1  7. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting  ~~[~~8. Supported values of the maximum number of observation number~~]~~  9. Value for CPU occupation, when P/SP-CSI-RS is configured for CMR  10. Value for CPU occupation, when A-CSI-RS is configured for CMR | 58-3-1 | yes | n/a | CSI prediction for N4>1 for inference is not supported | ~~[~~Per band and Per BC~~]~~ | ~~FFS~~ N/A | ~~FFS~~ N/A | ~~FFS~~ N/A | ~~FFS: CPU/AIMLPU related information~~  Component 3 candidate values: ~~FFS~~  a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {2,3,4 … 64}  d. {4, …, 256}  Component 7 candidate values:  a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {4,8,12}  d.{4, …, 256}  Component 9 candidate values when P/SP-CSI-RS is configured for CMR:  O\_CPU=Y\_2⋅N\_4, Y\_2∈{0,1,2,3}  O\_APU=X\_2⋅N\_4, X\_2∈{0,1,2,3}  Component 10 candidate values:  - when A-CSI-RS is configured for CMR and K<12, where where K is the number of A-CSI-RS resources:  O\_CPU=M=Y\_1 K, Y\_1∈{0,1,2,3}  O\_APU=N=X\_1 K,  X\_1∈{0,1,2,3}  - When K=12:  O\_CPU=M, M={0…8}  O\_APU=N, N={0…8} | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | The components 9 and 10 are not necessary since 58-3-1 is the prerequisite. |
| Qualcomm | Component 9 and 10 are needed because complexity for N4=1 and N4 > 1 are different. But they should be O\_CPU value and O\_APU value, not the way it is formulated in current version. |

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-3-4 | UE side data collection for CSI prediction | 1. Support of data collection for CSI prediction | FFS | yes | n/a | UE side data collection for CSI prediction is not supported | ~~FFS~~ Per band and Per BC | ~~FFS~~ N/A | ~~FFS~~ N/A | ~~FFS~~ N/A |  | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | Suggest 2-35 as the prerequisite. |

**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-3-3 | Aperiodic CSI report timing relaxation | Support of aperiodic CSI report time relaxation is equal to t + Z/Z’ | 58-3-1, 58-3-2 | Yes | n/a | Aperiodic CSI report timing relaxation is not supported | FFS | FFS | FFS | FFS | The value of t could be equal to or , where , | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | The component values need further discussion. |

**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-3-5 | Performance monitoring for CSI prediction model | 1. Performance metric SGCS  2. One wideband frequency gruanularity SGCS per layer  3. One monitoring resource set  4. One configured time instance for N4>1 | 58-3-1 | Yes | n/a | Performance monitoring for CSI prediction model is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | Support |
| Qualcomm | Monitoring is a CSI report, so the basic component should include CSI-RS triplets, i.e., component 3 of 58-3-1.  “A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously” |

**Proposal: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 58. NR\_AIML\_Air | 58-3-6 | Data collection for UE-side CSI prediction | 1. Support periodic and semi-persistent CSI-RS resource  2. Number of CSI-RS resources | 58-3-1 | Yes | n/a | Data collection for UE-side CSI prediction is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | This one seems duplicated with 58-3-4? We believe this should be removed. |

# Conclusion

Agreements reached during RAN1 #122 as part of this agenda item are summarized in [ ].

# References

1. R1-2504673, Updated RAN1 UE features list for Rel-19 NR after RAN1 #121, Moderators (AT&T, NTT DOCOMO, INC.)
2. R1-2505179, UE Features for Rel-19 AI/ML for NR Air Interface, Ericsson Telecom S.A. de C.V.
3. R1-2505189, UE features for AI/ML for NR Air Interface, Nokia
4. R1-2505334, Discussion on UE features for AI/ML for NR Air Interface, CATT/CICTCI
5. R1-2505343, UE features for AI/ML for NR air interface, Huawei/HiSilicon
6. R1-2505394, UE features for AI/ML for NR Air Interface, vivo
7. R1-2505443, Discussion on UE features for AI/ML for NR Air Interface, Xiaomi
8. R1-2505489, Discussion on UE features for AI/ML for NR Air Interface, ZTE Corporation/Sanechips
9. R1-2505560, Remaining issues on UE features for AI/ML for NR air interface, Samsung
10. R1-2505667, Views on Rel-19 UE features for AI/ML for NR Air Interface, Ofinno
11. R1-2505734, UE features for AIML for NR air interface, OPPO
12. R1-2505818 Discussion on UE features for AI/ML for NR Air Interface, LG Electronics
13. R1-2505893, Views on UE features for AI/ML for NR Air Interface, Apple
14. R1-2506086, Discussion on UE features for AI/ML for NR air Interface, CMCC
15. R1-2506195 UE features for AI/ML for NR air interface, Qualcomm Incorporated
16. R1-2506284, Discussion on UE features for AI/ML for NR Air Interface, NTT DOCOMO, INC.