**3GPP TSG RAN WG1 #100bis-e R1-2002455**

e-Meeting, April 20th – 30th, 2020

Source: NTT DOCOMO, INC.

Title: Summary on UE features for CLI/RIM

Agenda Item: 7.2.11.11

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

# **Introduction**

This contribution summarizes the discussions and proposals in AI 7.2.11.11 regarding UE features for NR CLI/RIM.

In R1-2001484 [1] which is the version after [100e-NR-Rel-16-UEFeatures] email discussion, there are following feature groups for NR CLI/RIM.

* 17-1 CLI-RSSI measurement
* 17-2 SRS-RSRP measurement
* 17-3 Simultaneous reception of PDSCH and CLI-RSSI measurement resource
* 17-4 Simultaneous reception of PDSCH and SRS-RSRP measurement resource

Based on the discussions summarized in Section 2-5, following is the suggested list of issues to be discussed and priority order considering RAN2 impact especially for capability signaling design.

**FL proposal of list of issues/proposals and priority:**

**1st priority issues (such as components, type and xDD/FRx differentiation that have capability signaling impacts):**

* **17-1**
  + **Whether the maximum number of measurement resources configured for CLI-RSSI measurement is reported or not**
    - **Alt.1: UE reports both maximum number of measurement resources configured for CLI-RSSI measurement and maximum number of measurement resources configured for CLI-RSSI measurement within one slot**
    - **Alt.2: UE reports maximum number of measurement resources configured for CLI-RSSI measurement**
    - **Alt.3: UE has to support 64 CLI-RSSI measurement resource in order to support CLI-RSSI**
  + **If the maximum number of measurement resources configured for CLI-RSSI measurement is reported in FG17-1, what are candidate values**
  + **Whether the component 2 “Subcarrier spacing for CLI-RSSI measurement is same as subcarrier spacing for active BWP” is necessary or not**
  + **Whether FG17-1 is reported per band or per UE**
* **17-2**
  + **Whether the maximum number of measurement resources configured for SRS-RSRP measurement is reported or not**
    - **Alt.1: UE reports both maximum number of measurement resources configured for SRS-RSRP measurement and maximum number of measurement resources configured for SRS-RSRP measurement within one slot**
    - **Alt.2: UE reports maximum number of measurement resources configured for SRS-RSRP measurement**
    - **Alt.3: UE has to support 32 SRS-RSRP measurement resource in order to support SRS-RSRP**
  + **If the maximum number of measurement resources configured for SRS-RSRP measurement is reported in FG17-2, what are candidate values**
  + **Whether FG17-2 is reported per band or per UE**
  + **Whether a joint limit for CLI SRS, SSB and CSI-RS for RSRP measurement in a slot is necessary or not**
  + **Whether NR supports multi-port SRS-RSRP measurement or not**

**2nd priority issues:**

* **17-3**
  + **Which kind of DL channels and signals can be FDMed with CLI measurement resource in UE capabilities**
    - **Alt.1: PDSCH**
    - **Alt.2: DL signal/channel**
    - **Alt.3: PDCCH/PDSCH/CSI-RS**
  + **Whether/how to describe “consequence if feature is not supported by the UE” for FG17-3**
    - **Alt.1: If not supported, then UE does not expect to receive PDCCH/PDSCH when it performs CLI-RSSI measurement**
    - **Alt.2: Other if any**
  + **Whether the sentence “if not supported that UE only receives CLI-RSSI resources” for component of FG17-3 is necessary or not**
* **17-4**
  + **Which kind of DL channels and signals can be FDMed with CLI measurement resource in UE capabilities**
    - **Alt.1: PDSCH**
    - **Alt.2: DL signal/channel**
    - **Alt.3: PDCCH/PDSCH/CSI-RS**
  + **Whether/how to describe “consequence if feature is not supported by the UE” for FG17-4**
    - **Alt.1: If not supported, then UE does not expect to receive PDCCH/PDSCH when it performs SRS-RSRP measurement**
    - **Alt.2: Other if any**
  + **Whether the sentence “if not supported that UE only receives SRS-RSRP resources” for component of FG17-4 is necessary or not**

Companies are encouraged to check above FL proposals and to provide feedback if any in below.

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | It would be OK to first discuss 17-1 and 17-2 because 17-3 and 17-4 have some dependency from RAN2 and RAN4 agreements and then further inputs from RAN2 and RAN4 may be necessary. |
| Nokia, Nokia Shanghai Bell | We agree to focusing the discussion on 17-1 and 17-2 first. |
| Huawei, HiSilicon | Agree to focus on 17-1 and 17-2 first because 17-3 and 17-4 have the dependency on RAN2 decision and response to LS R1-2001523. |

# **Updated FL Proposals**

The moderator recommends following email discussions for FL Proposals 1 and 2 (only if following condition is met).

* High priority items are recommended for discussion starting Monday, April 20th, 2020. Ideally, discussions on high priority items can be concluded by Friday, April 24, 2020.
* Medium priority items are recommended for discussion starting at the time that high priority items are (almost) converged before Monday, April 27th, 2020, otherwise starting at Monday, April 27th, 2020.
* Low priority items are recommended for discussion starting at Monday, April 27th, 2020 only if high and medium priority items are converged before Monday, April 27th, 2020. Otherwise, discussion on low priority items will be postponed to next RAN1 meeting.

**FL Proposal 1 (high priority): Email discussion/approval on issues with capability signaling impacts for CLI/RIM (TBD)**

* **Confirm to keep FG17-1/2/3/4**
* **Discuss following on FG17-1**
  + **Whether the maximum number of measurement resources configured for CLI-RSSI measurement is reported or not**
    - **Alt.1: UE reports both maximum number of measurement resources configured for CLI-RSSI measurement and maximum number of measurement resources configured for CLI-RSSI measurement within one slot**
    - **Alt.2: UE reports maximum number of measurement resources configured for CLI-RSSI measurement**
    - **Alt.3: UE has to support 64 CLI-RSSI measurement resource in order to support CLI-RSSI**
  + **If the maximum number of measurement resources configured for CLI-RSSI measurement is reported in FG17-1, what are candidate values**
  + **Whether the component 2 “Subcarrier spacing for CLI-RSSI measurement is same as subcarrier spacing for active BWP” is necessary or not**
  + **Whether FG17-1 is reported per band or per UE**
* **Discuss followings on FG17-2**
  + **Whether the maximum number of measurement resources configured for SRS-RSRP measurement is reported or not**
    - **Alt.1: UE reports both maximum number of measurement resources configured for SRS-RSRP measurement and maximum number of measurement resources configured for SRS-RSRP measurement within one slot**
    - **Alt.2: UE reports maximum number of measurement resources configured for SRS-RSRP measurement**
    - **Alt.3: UE has to support 32 SRS-RSRP measurement resource in order to support SRS-RSRP**
  + **If the maximum number of measurement resources configured for SRS-RSRP measurement is reported in FG17-2, what are candidate values**
  + **Whether FG17-2 is reported per band or per UE**
  + **Whether a joint limit for CLI SRS, SSB and CSI-RS for RSRP measurement in a slot is necessary or not**
  + **Whether NR supports multi-port SRS-RSRP measurement or not**

**FL Proposal 2 (low priority): Email discussion/approval on FG17-3 and FG17-4 for CLI/RIM (TBD)**

* **Discuss followings on FG17-3**
  + **Which kind of DL channels and signals can be FDMed with CLI measurement resource in UE capabilities**
    - **Alt.1: PDSCH**
    - **Alt.2: DL signal/channel**
    - **Alt.3: PDCCH/PDSCH/CSI-RS**
  + **Whether/how to describe “consequence if feature is not supported by the UE” for FG17-3**
    - **Alt.1: If not supported, then UE does not expect to receive PDCCH/PDSCH when it performs CLI-RSSI measurement**
    - **Alt.2: Other if any**
  + **Whether the sentence “if not supported that UE only receives CLI-RSSI resources” for component of FG17-3 is necessary or not**
* **Discuss followings on FG17-4**
  + **Which kind of DL channels and signals can be FDMed with CLI measurement resource in UE capabilities**
    - **Alt.1: PDSCH**
    - **Alt.2: DL signal/channel**
    - **Alt.3: PDCCH/PDSCH/CSI-RS**
  + **Whether/how to describe “consequence if feature is not supported by the UE” for FG17-4**
    - **Alt.1: If not supported, then UE does not expect to receive PDCCH/PDSCH when it performs SRS-RSRP measurement**
    - **Alt.2: Other if any**
  + **Whether the sentence “if not supported that UE only receives SRS-RSRP resources” for component of FG17-4 is necessary or not**

# **17-1: CLI-RSSI measurement**

In [1], FG17-1 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 17. NR\_CLI\_RIM | 17-1 | CLI-RSSI measurement | 1) Support CLI-RSSI measurement, The max number of resources across all CCs configured to measure RSSI simultaneously shall not exceed 64  2) Subcarrier spacing for CLI-RSSI measurement is same as subcarrier spacing for active BWP. |  |  | N/A |  | [Per UE] | TDD only | Yes |  | UE operates CLI-RSSI measurement. | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| [2] | ZTE, Sanechips | Since RAN1 has already agreed that the number of SRS to be monitored by the UE should not exceed 8 within a slot. We do not think it is necessary for the UE to indicate the maximum number of SRS-RSRP measurement resources it supports simultaneously.  Besides, some companies proposed to define a limit across all reference signals for RSRP measurement including SRS, SSB and CSI-RS[1] or reuse any existing UE capability(ies), e.g. *maxNumberSSB-CSI-RS-ResourceOneTx* (defined in TS 38.306). In our opinion, SRS here is used for CLI measurement, so it does not have the same measurement function as other signals, e.g. SSB and CSI-RS. Reusing the existing UE capability(ies) will inevitably affect the measurement requirements and the number of available resources of other signals. So we do not recommend that.  Although CLI-RSSI has no similar agreements on the maximum number of measurement resources within a slot, CLI-RSSI measurement complexity is relatively low and it is also an optional feature. So we do not think that the UE needs to report the maximum number of CLI-RSSI measurement resources, either.  **Proposal 1: It is unnecessary for a UE to report the maximum number of SRS-RSRP and CLI-RSSI measurement resources if it supports feature group 17-1 and 17-2.**  For UE feature type, “Per UE” is preferred only with the limit on TDD bands.  **Proposal 2: For UE feature type, “Per UE” is preferred only with the limit on TDD bands for 17-1 to 17-4.**   |  |  |  | | --- | --- | --- | | 17-1 | CLI-RSSI measurement | 1) Support CLI-RSSI measurement, The max number of resources across all CCs configured to measure RSSI shall not exceed 64  2) Subcarrier spacing for CLI-RSSI measurement is same as subcarrier spacing for active BWP. | |
| [3] | OPPO | Considering various UE capabilities, the maximum number of measurement resources for CLI-RSSI measurement shall be part of UE capability and shall be reported by the UE. Furthermore, the maximum number of measurement resources for CLI-RSSI measurement within one slot shall be UE capability too.  As we agreed, the subcarrier spacing for CLI measurement resource can be same or different from the subcarrier spacing of the active BWP. However, measuring CLI measurement resource with same or different subcarrier spacing would require totally different UE capability. It is preferred to support UE reporting whether support measuring CLI measurement with different subcarrier spacings.  Proposal 1: For FG17-1, CLI-RSSI measurement, support the UE reports the followings:   * maximum number of measurement resources configured for CLI-RSSI measurement.   + The candidate value can be {8, 16, 32, 64} * maximum number of measurement resources configured for CLI-RSSI measurement within one slot   + The candidate value can be {1, 2, 4, 8}  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 17-1 | CLI-RSSI measurement | * Support CLI-RSSI measurement,  1. The maximum number of resources across all CCs 2. The maximum number of resources within one slot 3. Subcarrier spacing for CLI-RSSI measurement is same as subcarrier spacing for active BWP |  |  | N/A |  | Per UE | TDD only | Yes |  | UE operates CLI-RSSI measurement. | Optional with capability signalling | |
| [5] | Ericsson | During the email discussion of the UE features, there were proposals to allow UEs to indicate the maximum supported number of resources across all CCs configured to measure PDSCH CLI-RSSI(17-1) and SRS-RSRP(17-2) simultaneously. This we consider an unnecessary fragmentation of the UE population. Similarly, there were proposals to change the indication from “Per UE” to “Per band”. The motivation for only supporting this function in certain bands are unclear. Hence, we propose:   1. The definitions of 17-1 and 17-2 to are kept as they are with no indication of the number of measurements supported and “Per UE” indication |
| [6] | vivo | Current version does not allow UE to report the max number of CLI-RSSI measurement resource, which means UE has to support 64 RSSI measurement resource in order to support CLI. This will unnecessarily increase the UE implementation burden for supporting the CLI feature. There was similar example in Rel-15 that UE is able to indicate the maximum total number of configured NZP-CSI-RS resources that are supported by the UE for 'CRI/RSRP' reporting across all serving cells, following the same design principle we should also allow UE to indicate the maximum number of CLI-RSSI measurement resource that are supported across all serving cells.   * **In 17-1, to allow UE report maximum number of CLI-RSSI measurement resource that are supported across all serving cells** |
| [7] | Nokia, Nokia Shanghai Bell | * 17-1, component 2 is not necessary:   In RAN1 100e meeting, RAN1 has discussed about the UE operation of CLI-RSSI measurement when the SCS of CLI-RSSI resource is different from the SCS of the active BWP. The conclusion is shown as below, and this has been sent to RAN2/RAN4 [2].  Based on the agreement, UE shall use the SCS of the active BWP while SCS of CLI-RSSI is used as a common reference in the serving cell across different BWPs to indicate a time-frequency resource as a form of the common reference. |
| [8] | Qualcomm Incorporated | On both FGs 17-1 and 17-2,   * Currently the UE can choose to either not support CLI measurement or support CLI measurement but always based on a hard-coded maximum number of 64 CLI RSSI measurement resources or 32 SRS resources. Due to this poor granularity, even if network/UE prefers to enable/perform CLI measurement, the UE may not able to support CLI measurement of such many measurement resources. There seems no obvious benefit to network if a flexible number of measurement resources supported by the UE is not allowed given that a UE may otherwise just totally give up CLI measurement. To avoid this problem, UE should be allowed to report the supported maximum number of measurement resources for SRS-RSRP and CLI-RSSI. The candidate value set can be FFS. * Because this has much more impact to UE PHY implementation than RAN2 signaling, we think this should be discussed in RAN1.   On both FGs 17-1 and 17-2, it is reasonable to allow the UE to report “Per band” support for CLI. For example, for CA case, UE can selectively support CLI measurement on Cells within PCell band but not on Cells inter-band with PCell. The current “Per UE” report has too coarse granularity. We propose to use “Per band”.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 17-1 | CLI-RSSI measurement | 1) Support CLI-RSSI measurement. The max number of resources across all CCs configured to measure CLI-RSSI shall not exceed MB\_1.  ~~2) Up to 64 of measurement resource for CLI-RSSI measurement~~  2) Subcarrier spacing for CLI-RSSI measurement is same as subcarrier spacing for active BWP. |  |  | N/A |  | Per band | TDD only | Yes |  | UE operates CLI-RSSI measurement.  1) Component-1, candidate value set for MB\_1 is {0, 8, 16, 32, 64}, with 0 indicating that UE does not support CLI-RSSI measurement.  2) Component-2, UE only supports using active BWP SCS to measure CLI RSSI. | Optional with capability signalling | |
| [9] | Huawei, HiSilicon | The wording in component 2) is not clear enough and probably misleading because it was agreed that configured reference SCS can be different from the SCS of active BWP. Therefore, suggest to replace it with “The configured SCS for the CLI-RSSI resource can be different with that of the active BWP, and the UE performs the CLI-RSSI measurement based on the SCS of the active BWP.” As agreed in R1-2001320.  ***Proposal 1:*** *Replace component 2) in FG 17-1 with “The configured SCS for the CLI-RSSI resource can be different with that of the active BWP, and the UE performs the CLI-RSSI measurement based on the SCS of the active BWP.”*   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 17-1 | CLI-RSSI measurement | 1) Support CLI-RSSI measurement, The max number of resources across all CCs configured to measure RSSI simultaneously shall not exceed 64  ~~2) Up to 64 of measurement resource for CLI-RSSI measurement~~  2) The configured SCS for the CLI-RSSI resource can be different with that of the active BWP, and the UE performs the CLI-RSSI measurement based on the SCS of the active BWP. |  | [Per UE] | TDD only | Yes | UE operates CLI-RSSI measurement. | Optional with capability signalling | |
| [10] | Intel Corporation | The constraint is for the maximum number of CLI measurement resources configured to a UE. It is not the constraint for the maximum number of CLI measurement resource to be measured simultaneously by a UE. As illustrated in the following figure, if a UE is configured with 64 SRS-RSRP measurement resources but there are only 4 SRS-RSRP measurement resources would be measured simultaneously, then such configuration still violates the agreement made in RAN1 #96, as the total number of SRS-RSRP resources configured exceeds the limit of 32.    Therefore, we propose to rephrase the first component in FG 17-1 and 17-2 as “the maximum number of CLI measurement resources across all CCs shall not exceed” 64 for CLI-RSSI and 32 for SRS-RSRP.   * FG 17-1: Support CLI-RSSI measurement. The maximum number of CLI-RSSI measurement resources configured for a UE across all CCs shall not exceed 64. |

**Based on above, following points should be discussed for FG17-1.**

* **Whether the maximum number of measurement resources configured for CLI-RSSI measurement is reported or not**
  + **Alt.1: UE reports both maximum number of measurement resources configured for CLI-RSSI measurement and maximum number of measurement resources configured for CLI-RSSI measurement within one slot**
  + **Alt.2: UE reports maximum number of measurement resources configured for CLI-RSSI measurement**
  + **Alt.3: UE has to support 64 CLI-RSSI measurement resource in order to support CLI-RSSI**
* **If the maximum number of measurement resources configured for CLI-RSSI measurement is reported in FG17-1, what are candidate values**
* **Whether the component 2 “Subcarrier spacing for CLI-RSSI measurement is same as subcarrier spacing for active BWP” is necessary or not**
* **Whether FG17-1 is reported per band or per UE**

# **17-2: SRS-RSRP measurement**

In [1], FG17-2 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 17. NR\_CLI\_RIM | 17-2 | SRS-RSRP measurement | 1) Support SRS-RSRP measurement, The max number of SRS resources across all CCs configured to measure SRS-RSRP simultaneously shall not exceed 32 |  |  | N/A |  | [Per UE] | TDD only | Yes |  | UE operates SRS-RSRP measurement. | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| [2] | ZTE, Sanechips | Since RAN1 has already agreed that the number of SRS to be monitored by the UE should not exceed 8 within a slot. We do not think it is necessary for the UE to indicate the maximum number of SRS-RSRP measurement resources it supports simultaneously.  Besides, some companies proposed to define a limit across all reference signals for RSRP measurement including SRS, SSB and CSI-RS[1] or reuse any existing UE capability(ies), e.g. *maxNumberSSB-CSI-RS-ResourceOneTx* (defined in TS 38.306). In our opinion, SRS here is used for CLI measurement, so it does not have the same measurement function as other signals, e.g. SSB and CSI-RS. Reusing the existing UE capability(ies) will inevitably affect the measurement requirements and the number of available resources of other signals. So we do not recommend that.  Although CLI-RSSI has no similar agreements on the maximum number of measurement resources within a slot, CLI-RSSI measurement complexity is relatively low and it is also an optional feature. So we do not think that the UE needs to report the maximum number of CLI-RSSI measurement resources, either.  **Proposal 1: It is unnecessary for a UE to report the maximum number of SRS-RSRP and CLI-RSSI measurement resources if it supports feature group 17-1 and 17-2.**  For UE feature type, “Per UE” is preferred only with the limit on TDD bands.  **Proposal 2: For UE feature type, “Per UE” is preferred only with the limit on TDD bands for 17-1 to 17-4.**   |  |  |  | | --- | --- | --- | | 17-2 | SRS-RSRP measurement | 1) Support SRS-RSRP measurement, The max number of SRS resources across all CCs configured to measure SRS-RSRP shall not exceed 32. The max number of SRS resources across all CCs configured to measure SRS-RSRP shall not exceed 8 within a slot. | |
| [3] | OPPO | Similar to the CLI-RSSI measurement resources, the maximum number of SRS resources that can be configured for SRS-RSRP measurement shall be a UE capability and the maximum number of SRS resources that can be configured within one slot for SRS-RSRP measurement shall be a UE capability too.  Proposal 2: For FG17-2, SRS-RSRP measurement, support the UE reports the followings:   * maximum number of SRS resources configured for SRS-RSRP measurement per UE. The candidate value can be {4, 8, 16, 32} * maximum number of SRS resources configured for SRS-RSRP measurement within one slot. The candidate value can be {1, 2, 4, 8}  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 17-2 | SRS-RSRP measurement | * Support SRS-RSRP measurement   1. The maximum number of SRS resources across all CCs   2. The maximum number of SRS resources within one slot |  |  | N/A |  | Per UE | TDD only | Yes |  | UE operates SRS-RSRP measurement. | Optional with capability signalling | |
| [4] | Samsung | It was proposed to define a joint limit for CLI SRS, SSB and CSI-RS for RSRP measurement in a slot. The following aspects should be clarified with further discussion. First, in case the capability for CLI SRS-RSRP measurement is combined with the SSB/CSI-RS, there may be impacts on the SSB/CSI-RS measurements based on the existing capability. For example, if the CLI SRS-RSRP measurement is counted in a slot toward *maxNumberSSB-CSI-RS-ResourceOneTx*, beam measurements for the SSB/CSI-RS resources would be impacted compared to Rel-15 UEs.  **Observation 1: There may be impacts on the SSB/CSI-RS measurements based on the existing capability due to the joint limit.**  Second, SSB/CSI-RS measurement based on *maxNumberSSB-CSI-RS-ResourceOneTx* is L1-RSRP measurement. On the other hand, CLI SRS-RSRP measurement is L3-RSRP measurement. In our view, it is weird that both L1-RSRP and L3-RSRP measurements are combined within a UE feature.  **Observation 2: Both L1-RSRP and L3-RSRP measurements should not be combined within a UE feature.**  Third, regarding the number of SRS ports, it was agreed to support single antenna port for SRS-RSRP measurement. But, there is still FFS for a support of 2 and 4 ports.  **Observation 3: Single antenna port for SRS-RSRP measurement was agreed with FFS for a support of 2 and 4 ports.**  **Proposal 1: Based on the observations, further discuss a joint limit for CLI SRS, SSB and CSI-RS for RSRP measurement in a slot.** |
| [5] | Ericsson | During the email discussion of the UE features, there were proposals to allow UEs to indicate the maximum supported number of resources across all CCs configured to measure PDSCH CLI-RSSI(17-1) and SRS-RSRP(17-2) simultaneously. This we consider an unnecessary fragmentation of the UE population. Similarly, there were proposals to change the indication from “Per UE” to “Per band”. The motivation for only supporting this function in certain bands are unclear. Hence, we propose:   1. The definitions of 17-1 and 17-2 to are kept as they are with no indication of the number of measurements supported and “Per UE” indication |
| [6] | vivo | Similarly, as above, we think there is also a need to allow UE to indicate the maximum number of SRS-RSRP measurement resource that are supported across all serving cells.   * **In 17-2, to allow UE report maximum number of CLI-RSRP measurement resource that are supported across all serving cells.** |
| [8] | Qualcomm Incorporated | On both FGs 17-1 and 17-2,   * Currently the UE can choose to either not support CLI measurement or support CLI measurement but always based on a hard-coded maximum number of 64 CLI RSSI measurement resources or 32 SRS resources. Due to this poor granularity, even if network/UE prefers to enable/perform CLI measurement, the UE may not able to support CLI measurement of such many measurement resources. There seems no obvious benefit to network if a flexible number of measurement resources supported by the UE is not allowed given that a UE may otherwise just totally give up CLI measurement. To avoid this problem, UE should be allowed to report the supported maximum number of measurement resources for SRS-RSRP and CLI-RSSI. The candidate value set can be FFS. * Because this has much more impact to UE PHY implementation than RAN2 signaling, we think this should be discussed in RAN1.   On both FGs 17-1 and 17-2, it is reasonable to allow the UE to report “Per band” support for CLI. For example, for CA case, UE can selectively support CLI measurement on Cells within PCell band but not on Cells inter-band with PCell. The current “Per UE” report has too coarse granularity. We propose to use “Per band”.  On FG 17-2, we would like to further clarify that RSRP measurement is a computationally demanding operation to UE. Currently RSRP can be measured based on three resources: SSB, CSI-RS and SRS. They together determine the UE complexity for RSRP measurement. It would be necessary to define a joint limit for all these reference signals per port across CLI SRS, SSB and CSI-RS for RSRP measurement in a slot. Besides, we noticed that in TS 38.331, RAN2 has agreed to configure only single port SRS resrouces for CLI SRS-RSRP measurement.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 17-2 | SRS-RSRP measurement | 1) Support SRS-RSRP measurement. The max number of SRS resources across all CCs configured to measure SRS-RSRP shall not exceed MC\_1.  ~~2) Up to 32 of SRS resources to be monitored by a UE~~  2) The max number of SSB/CSI-RS (1Tx) (sum of aperiodic/periodic/semi-persistent) and CLI SRS-RSRP resource ports across all CCs configured to measure L1-RSRP 'CRI/RSRP', 'SSBRI/RSRP' and ‘CLI SRS-RSRP’ within a slot shall not exceed MD\_1. |  |  | N/A |  | Per band | TDD only | Yes |  | UE operates SRS-RSRP measurement.  1) Component -1, candidate value set for MC\_1 is {0, 8, 16, 32}, with 0 indicating that UE does not support CLI SRS-RSRP measurement  2) Component-2, candidate value set for MD\_1 is {0, 8, 16, 32, 64} | Optional with capability signalling | |
| [10] | Intel Corporation | The constraint is for the maximum number of CLI measurement resources configured to a UE. It is not the constraint for the maximum number of CLI measurement resource to be measured simultaneously by a UE. As illustrated in the following figure, if a UE is configured with 64 SRS-RSRP measurement resources but there are only 4 SRS-RSRP measurement resources would be measured simultaneously, then such configuration still violates the agreement made in RAN1 #96, as the total number of SRS-RSRP resources configured exceeds the limit of 32.    Therefore, we propose to rephrase the first component in FG 17-1 and 17-2 as “the maximum number of CLI measurement resources across all CCs shall not exceed” 64 for CLI-RSSI and 32 for SRS-RSRP.   * FG 17-2: Support SRS-RSRP measurement. The maximum number of SRS-RSRP measurement resources monitored by a UE across all CCs shall not exceed 32.   In R1-1903835 [3], the value range of *nrofSRS-Ports* in *SRS-RSRP-Measurement-ResourceConfig* is listed as “1, [2], [4]”.  In TS 38.331 version 16.0.0 [4], section 6.3.2, the field description for *nrofSRS-Ports* in RRC IE *SRS-Resource* states: “For CLI SRS-RSRP measurement, the network always configures this parameter to 'port1'.”  Therefore, only single-port SRS can be configured for SRS-RSRP measurement in NR R-16. RAN1 should decide whether to support two-port or four-port SRS-RSRP measurement. If RAN1 decided to support multi-port SRS-RSRP measurement, then the constraint that only single-port SRS can be configured for SRS-RSRP measurement should be removed in TS 38.331.  **Proposal 2:** Discuss and decide whether NR supports multi-port SRS-RSRP measurement. A LS to RAN2 would be needed to inform RAN1’s final decision. |

**Based on above, following points should be discussed for FG17-2.**

* **Whether the maximum number of measurement resources configured for SRS-RSRP measurement is reported or not**
  + **Alt.1: UE reports both maximum number of measurement resources configured for SRS-RSRP measurement and maximum number of measurement resources configured for SRS-RSRP measurement within one slot**
  + **Alt.2: UE reports maximum number of measurement resources configured for SRS-RSRP measurement**
  + **Alt.3: UE has to support 32 SRS-RSRP measurement resource in order to support SRS-RSRP**
* **If the maximum number of measurement resources configured for SRS-RSRP measurement is reported in FG17-2, what are candidate values**
* **Whether FG17-2 is reported per band or per UE**
* **Whether a joint limit for CLI SRS, SSB and CSI-RS for RSRP measurement in a slot is necessary or not**
* **Whether NR supports multi-port SRS-RSRP measurement or not**

# **17-3: Simultaneous reception of PDSCH and CLI-RSSI measurement resource**

In [1], FG17-3 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 17. NR\_CLI\_RIM I | 17-3 | Simultaneous reception of PDSCH and CLI-RSSI measurement resource | Support simultaneousRxPDSCHCLIRSSIMeasResource if not supported that UE only receives CLI-RSSI resources’ | 17-1 |  | N/A |  | Per UE | TDD only | Yes |  | UE can assume that PDSCH is FDMed with CLI-RSSI measurement resource(s) | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| [2] | ZTE, Sanechips | At present, RAN2 and RAN4 are trying to resolve theses conflicts between above agreements reached in each WG [3]. RAN1 can wait for the final decision from RAN2 and RAN4. Therefore, we suggest to delete the descriptions related to UE detection behaviour if an UE indicates the FDMed reception is not supported.  **Proposal 3: RAN1 can wait for final decisions from RAN2 and RAN4 on UE behaviour if a UE indicates the FDMed reception is not supported, since the current agreements reached in RAN2 and RAN4 respectively are conflicting. The relevant descriptions in Components in feature group 17-3 and 17-4 need to be deleted.**  In addition, it can be seen that there are different descriptions among RAN1, RAN2 and RAN4 on which kind of DL channels and signals can be FDMed with CLI measurement resource in UE capabilities.   * RAN1: PDSCH * RAN2: DL signal/channel * RAN4: PDCCH/PDSCH   To avoid unnecessary confusion, we recommend that RAN1, RAN2 and RAN4 to align the definitions and descriptions on which kinds of DL channels and signals and CLI measurement resource are FDMed.  **Proposal 4: RAN1, RAN2 and RAN4 should align their descriptions on which kind of DL channels and signals can be FDMed with CLI measurement resource in**  **feature group 17-3 and 17-4.**   |  |  |  | | --- | --- | --- | | 17-3 | Simultaneous reception of DL and CLI-RSSI measurement resource | Support simultaneousRxDLCLIRSSIMeasResource | |
| [4] | Samsung | In our view, descriptions in components for FG 17-3 & 17-4 should be aligned with what RAN1 agreed as well as what RAN2 agreed. Even though RAN2 agreed the DL transmission in DL signal/channel, it should be restricted to the PDSCH reception based on the RAN1 agreement. Therefore, it should be revised as follows:   |  |  |  | | --- | --- | --- | | 17-3 | Simultaneous reception of PDSCH and CLI-RSSI measurement resource | Support simultaneousRxPDSCHCLIRSSIMeasResource if not supported that UE shall prioritize the PDSCH reception | |
| [5] | Ericsson | According to our understanding, 17-3 and 17-4 have already been defined by RAN2. Hence, it should be clearly indicated to RAN2 that these are not additional capabilities but contain definitions by RAN1.   1. Clarify for RAN2 that 17-3 and 17-4 are the same capabilities as already defined by RAN2 and that the RAN1 definitions should be included when finalizing these. |
| [8] | Qualcomm Incorporated | On both FGs 17-3 and 17-4, RAN2’s understanding in their agreement below is that the FDM capability applies to general serving cell DL signal/channel. This is reasonable because if a UE cannot support FDMed reception between PDSCH and CLI, it cannot support FDMed reception between other DL signal/channel such as PDCCH/CSI-RS and CLI either.  RAN4 also agreed that UE can report its support for FDMed receipton of CLI and serving cell PDSCH/PDCCH/CSI-RS.  Based on this, we propose to include PDCCH and CSI-RS in the capability together with PDSCH.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 17-3 | Simultaneous reception of PDSCH/PDCCH/CSI-RS and CLI-RSSI measurement resource | Support simultaneousRxPDSCHCLIRSSIMeasResource if not supported UE only receives CLI-RSSI resources | 17-1 |  | N/A |  | Per UE | TDD only | Yes |  | UE can assume that PDSCH/PDCCH/CSI-RS is FDMed with CLI-RSSI measurement resource(s) | Optional with capability signalling | |
| [9] | Huawei, HiSilicon | Please put the sentence in brackets “if not supported that UE only receives CLI-RSSI resources”, because it is not aligned with current RAN2 agreement and RAN4 has provided such a view in R1-2001523 to RAN2. It is not good for RAN1 to draw a decision now for such discrepancy, which may need more discussions between RAN2 and RAN4, or more in RAN1.  ***Proposal 2:*** *Put the sentence in brackets “if not supported that UE only receives CLI-RSSI resources” in FG 17-3*   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 17-3 | Simultaneous reception of PDSCH and CLI-RSSI measurement resource | Support simultaneousRxPDSCHCLIRSSIMeasResource [if not supported that UE only receives CLI-RSSI resources] | 17-1 | Per UE | TDD only | Yes | UE can assume that PDSCH is FDMed with CLI-RSSI measurement resource(s) | Optional with capability signalling | |
| [10] | Intel Corporation | If a UE does not support simultaneous reception of PDSCH and CLI measurement, then the FDMed PDSCH and CLI measurement should be regarded as an error case. If a UE does not support this feature but FDMed PDSCH and CLI measurement are configured by network anyway, UE behavior in the error case was not discussed in RAN1. RAN2 and RAN4 have not reach consensus on such UE behavior. RAN2’s agreement prioritizes PDSCH reception over CLI measurement, but RAN4’s scheduling restriction essentially prioritizes CLI measurement. In R1-2001523 [5], RAN4 has asked RAN2 to reconsider UE behavior.  RAN1 should discuss UE behavior and the capture the agreement in the “consequence if feature is not supported by the UE” column of UE feature list document. For collision between CLI measurement and PDCCH/PDSCH, we suggest following RAN4’s scheduling restriction.  **Proposal 3:** For a UE does not support simultaneous reception of PDSCH and CLI measurement feature, capture its behavior in column “consequence if feature is not supported by the UE”, when PDSCH and CLI measurement are FDMed.   * FG 17-3: If not supported, then UE does not expect to receive PDCCH/PDSCH when it performs CLI-RSSI measurement   For collision between CLI measurement and DL signals, the prioritizing rule depends on whether the DL signal is cell-specific or UE-specific. The scheduling restrictions can be extended to UE-specific DL signals, e.g., DM-RS and PT-RS, because these signals are used for PDSCH reception. For cell-specific DL signals, the network should avoid conflicting configuration for UEs who do not support simultaneous reception. If an error case is evitable, then UE should prioritize the reception of cell-specific DL signals, such as SSB and periodic CSI-RS.  **Proposal 4:** If a UE does not support simultaneous reception of DL transmission and CLI measurement and a CLI measurement resource is FDMed with the following cell-specific DL signals, UE should prioritize the reception of DL signals   * SSB * Periodic CSI-RS   For other DL signals, such as aperiodic CSI-RS, DM-RS, PT-RS, etc., UE does not expect to receive these DL signals when it performs CLI measurement. |

**Based on above, following points should be discussed for FG17-3.**

* **Which kind of DL channels and signals can be FDMed with CLI measurement resource in UE capabilities**
  + **Alt.1: PDSCH**
  + **Alt.2: DL signal/channel**
  + **Alt.3: PDCCH/PDSCH/CSI-RS**
* **Whether/how to describe “consequence if feature is not supported by the UE” for FG17-3**
  + **Alt.1: If not supported, then UE does not expect to receive PDCCH/PDSCH when it performs CLI-RSSI measurement**
  + **Alt.2: Other if any**
* **Whether the sentence “if not supported that UE only receives CLI-RSSI resources” for component of FG17-3 is necessary or not**

# **17-4: Simultaneous reception of PDSCH and SRS-RSRP measurement resource**

In [1], FG17-4 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 17. NR\_CLI\_RIM I | 17-4 | Simultaneous reception of PDSCH and SRS-RSRP measurement resource | Support simultaneousRxPDSCHSRSRSRPMeasResource if not supported that UE only receives SRS-RSRP resources | 17-2 |  | N/A |  | Per UE | TDD only | Yes |  | UE can assume that PDSCH is FDMed with SRS RSRP measurement resource(s). | Optional with capability signalling |

Following feedback is provided in a contribution for the RAN1#100bis-e meeting.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| [2] | ZTE, Sanechips | At present, RAN2 and RAN4 are trying to resolve theses conflicts between above agreements reached in each WG [3]. RAN1 can wait for the final decision from RAN2 and RAN4. Therefore, we suggest to delete the descriptions related to UE detection behaviour if an UE indicates the FDMed reception is not supported.  **Proposal 3: RAN1 can wait for final decisions from RAN2 and RAN4 on UE behaviour if a UE indicates the FDMed reception is not supported, since the current agreements reached in RAN2 and RAN4 respectively are conflicting. The relevant descriptions in Components in feature group 17-3 and 17-4 need to be deleted.**  In addition, it can be seen that there are different descriptions among RAN1, RAN2 and RAN4 on which kind of DL channels and signals can be FDMed with CLI measurement resource in UE capabilities.   * RAN1: PDSCH * RAN2: DL signal/channel * RAN4: PDCCH/PDSCH   To avoid unnecessary confusion, we recommend that RAN1, RAN2 and RAN4 to align the definitions and descriptions on which kinds of DL channels and signals and CLI measurement resource are FDMed.  **Proposal 4: RAN1, RAN2 and RAN4 should align their descriptions on which kind of DL channels and signals can be FDMed with CLI measurement resource in feature group 17-3 and 17-4.**   |  |  |  | | --- | --- | --- | | 17-4 | Simultaneous reception of DL and SRS-RSRP measurement resource | Support simultaneousRxDLSRSRSRPMeasResource | |
| [4] | Samsung | In our view, descriptions in components for FG 17-3 & 17-4 should be aligned with what RAN1 agreed as well as what RAN2 agreed. Even though RAN2 agreed the DL transmission in DL signal/channel, it should be restricted to the PDSCH reception based on the RAN1 agreement. Therefore, it should be revised as follows:   |  |  |  | | --- | --- | --- | | 17-4 | Simultaneous reception of PDSCH and SRS-RSRP measurement resource | Support simultaneousRxPDSCHSRSRSRPMeasResource if not supported that UE shall prioritize the PDSCH reception | |
| [5] | Ericsson | According to our understanding, 17-3 and 17-4 have already been defined by RAN2. Hence, it should be clearly indicated to RAN2 that these are not additional capabilities but contain definitions by RAN1.   1. Clarify for RAN2 that 17-3 and 17-4 are the same capabilities as already defined by RAN2 and that the RAN1 definitions should be included when finalizing these. |
| [8] | Qualcomm Incorporated | On both FGs 17-3 and 17-4, RAN2’s understanding in their agreement below is that the FDM capability applies to general serving cell DL signal/channel. This is reasonable because if a UE cannot support FDMed reception between PDSCH and CLI, it cannot support FDMed reception between other DL signal/channel such as PDCCH/CSI-RS and CLI either.  RAN4 also agreed that UE can report its support for FDMed receipton of CLI and serving cell PDSCH/PDCCH/CSI-RS.  Based on this, we propose to include PDCCH and CSI-RS in the capability together with PDSCH.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 17-4 | Simultaneous reception of PDSCH/PDCCH/CSI-RS and SRS-RSRP measurement resource | Support simultaneousRxPDSCHSRSRSRPMeasResource if not supported UE only receives SRS-RSRP resources | 17-2 |  | N/A |  | Per UE | TDD only | Yes |  | UE can assume that PDSCH/PDCCH/CSI-RS is FDMed with SRS RSRP measurement resource(s). | Optional with capability signalling | |
| [9] | Huawei, HiSilicon | Similar to the comment above for 17-3, the sentence “if not supported that UE only receives SRS-RSRP resources” should be put within brackets.  ***Proposal 3:*** *Put the sentence in brackets “if not supported that UE only receives CLI-RSSI resources” in FG 17-4*   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 17-4 | Simultaneous reception of PDSCH and SRS-RSRP measurement resource | Support simultaneousRxPDSCHSRSRSRPMeasResource [if not supported that UE only receives SRS-RSRP resources] | 17-2 | Per UE | TDD only | Yes | UE can assume that PDSCH is FDMed with SRS RSRP measurement resource(s). | Optional with capability signalling | |
| [10] | Intel Corporation | If a UE does not support simultaneous reception of PDSCH and CLI measurement, then the FDMed PDSCH and CLI measurement should be regarded as an error case. If a UE does not support this feature but FDMed PDSCH and CLI measurement are configured by network anyway, UE behavior in the error case was not discussed in RAN1. RAN2 and RAN4 have not reach consensus on such UE behavior. RAN2’s agreement prioritizes PDSCH reception over CLI measurement, but RAN4’s scheduling restriction essentially prioritizes CLI measurement. In R1-2001523 [5], RAN4 has asked RAN2 to reconsider UE behavior.  RAN1 should discuss UE behavior and the capture the agreement in the “consequence if feature is not supported by the UE” column of UE feature list document. For collision between CLI measurement and PDCCH/PDSCH, we suggest following RAN4’s scheduling restriction.  **Proposal 3:** For a UE does not support simultaneous reception of PDSCH and CLI measurement feature, capture its behavior in column “consequence if feature is not supported by the UE”, when PDSCH and CLI measurement are FDMed.   * FG 17-4: If not supported, then UE does not expect to receive PDCCH/PDSCH when it performs SRS-RSRP measurement   For collision between CLI measurement and DL signals, the prioritizing rule depends on whether the DL signal is cell-specific or UE-specific. The scheduling restrictions can be extended to UE-specific DL signals, e.g., DM-RS and PT-RS, because these signals are used for PDSCH reception. For cell-specific DL signals, the network should avoid conflicting configuration for UEs who do not support simultaneous reception. If an error case is evitable, then UE should prioritize the reception of cell-specific DL signals, such as SSB and periodic CSI-RS.  **Proposal 4:** If a UE does not support simultaneous reception of DL transmission and CLI measurement and a CLI measurement resource is FDMed with the following cell-specific DL signals, UE should prioritize the reception of DL signals   * SSB * Periodic CSI-RS   For other DL signals, such as aperiodic CSI-RS, DM-RS, PT-RS, etc., UE does not expect to receive these DL signals when it performs CLI measurement. |

**Based on above, following points should be discussed for FG17-4.**

* **Which kind of DL channels and signals can be FDMed with CLI measurement resource in UE capabilities**
  + **Alt.1: PDSCH**
  + **Alt.2: DL signal/channel**
  + **Alt.3: PDCCH/PDSCH/CSI-RS**
* **Whether/how to describe “consequence if feature is not supported by the UE” for FG17-4**
  + **Alt.1: If not supported, then UE does not expect to receive PDCCH/PDSCH when it performs SRS-RSRP measurement**
  + **Alt.2: Other if any**
* **Whether the sentence “if not supported that UE only receives SRS-RSRP resources” for component of FG17-4 is necessary or not**

# **References**

[1] R1-2001484 RAN1 UE features list for Rel-16 NR after RAN1#100-E Moderator (AT&T, NTT DOCOMO, INC.)

[2] R1-2001588 Discussion on UE feature for CLI ZTE

[3] R1-2001740 Discussion on UE features for CLI/RIM OPPO

[4] R1-2002158 UE features for CLI/RIM Samsung

[5] R1-2002279 UE features for CLI/RIM Ericsson

[6] R1-2002404 Discussion on Rel-16 CLI UE features vivo

[7] R1-2002488 On UE features for CLI/RIM Nokia, Nokia Shanghai Bell

[8] R1-2002572 Discussion on UE features for CLI Qualcomm Incorporated

[9] R1-2002596 Rel-16 UE features for CLI/RIM Huawei, HiSilicon

[10] R1-2002686 UE features for CLI/RIM Intel Corporation