3GPP TSG-RAN WG4 Meeting #116 R4-2509691

Bengaluru, India, August 25th – 29th, 2025

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** | - | **Current version:** |  |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network |  |

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| ***Title:***  | draftCR on requirements of CSI-RS based L1-RSRP Reporting with SBFD |
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| ***Source to WG:*** | OPPO |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_duplex\_evo-Core |  | ***Date:*** | 2025-08-15 |
|  |  |  |  |  |
| ***Category:*** | B |  | ***Release:*** | Rel-19 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
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| ***Reason for change:*** | The requirements for CSI-RS based L1-RSRP Reporting needs to be updated for impact of SBFD operation. |
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| ***Summary of change:*** | Introduce updated CSI-RS based L1-RSRP measurement requirements due to the impact of SBFD operation.* Remove [].
* Add lower bound of 8ms to account for scaled processing time of CSI-RS across 2 DL subbands.
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| ***Consequences if not approved:*** | CSI-RS based L1-RSRP measurement requirements with SBFD operation are missing. |
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| ***Clauses affected:*** | 9.5.4.2 |
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|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **x** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

<Start of Change 1>

#### 9.5.4.2 CSI-RS based L1-RSRP Reporting

When *groupBasedBeamReporting-r17* is not configured, the UE shall be capable of performing L1-RSRP measurements based on the configured CSI-RS resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_CSI-RS.

When *groupBasedBeamReporting-r17* is configured, the UE shall be capable of performing L1-RSRP measurements based on the two configured CSI-RS resource sets for L1-RSRP, and the UE physical layer shall be capable of reporting group-based L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_CSI-RS.

The value of TL1-RSRP\_Measurement\_Period\_CSI-RS is defined in table 9.5.4.2-1 for FR1 and in table 9.5.4.2-2 for FR2, where

- For periodic and semi-persistent CSI-RS resources, M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- For aperiodic CSI-RS resources M=1

- For periodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply if *qcl-InfoPeriodicCSI-RS* is configured for all the resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For periodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set) for table 9.5.4.2-2, where Nres\_per\_set is number of resources in the resource set. The requirements apply provided *qcl-InfoPeriodicCSI-RS* is configured with QCL-TypeD for all resources in the resource set.

- For semi-persistent CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided TCI state is provided for all resources in the resource set in the MAC CE activating the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For semi-persistent CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided TCI state is provided with QCL-TypeD for all resources in the resource set in the MAC CE activating the resource set.

- For aperiodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided *qcl-info* is configured for all resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For aperiodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=1. UE is not required to meet the accuracy requirements in clauses 10.1.19.2 and 10.1.20.2 if number of resources in the resource set is smaller than *maxNumberRxBeam*. The requirements apply provided *qcl-info* is configured with QCL-TypeD for all resources in the resource set.

For the value of L1,

1> If UE does not support *supportSBFD* or SBFD is not configured by the network

2> L1=0

1> else (if UE supports *supportSBFD* and SBFD is configured by the network)

2> if higher layer parameter *timeRestrictionForChannelMeasurement* is configured

3> L1=0

2> else (if higher layer parameter *timeRestrictionForChannelMeasurement* is not configured)

3> if UE is configured to report L1-RSRP for SBFD symbols

4> When DRX is not configured, L1 is the number of occasions of the CSI-RS resource that are overlapping with dynamic UL transmission or with non-SBFD symbols during TL1-RSRP\_Measurement\_Period\_CSI-RS

4> When DRX is configured, L1 is the number of DRX cycles in which at least one occasion of the CSI-RS resource is overlapping with dynamic UL transmission or with non-SBFD symbols during TL1-RSRP\_Measurement\_Period\_CSI-RS

3> if UE is configured to report L1-RSRP for non-SBFD symbols

4> When DRX is not configured, L1 is the number of occasions of the CSI-RS resource that are overlapping with SBFD symbols during TL1-RSRP\_Measurement\_Period\_CSI-RS, when DRX is not configured

4> When DRX is configured, L1 is the number of DRX cycles in which at least one occasion of the CSI-RS resource is overlapping with SBFD symbols during TL1-RSRP\_Measurement\_Period\_CSI-RS

For a UE supporting [*support for Case 1 requirements*] and when concurrent measurement gap(s) with Pre-MG(s) are configured, or a UE supporting [*support for Case 2 requirements*] and when concurrent measurement gap(s) with NCSG measurement gap(s) are configured, or a UE supporting *concurrentMeasGap-r17* or *musim-GapPreference-r17* or both concurrent measurement gap and *musim-GapPreference-r17* and when concurrent gaps or periodic MUSIM gaps or both concurrent gaps and periodic MUSIM gaps are configured,

- a CSI-RS or an SMTC occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to clauses 9.1.8 and 9.1.10,

- P value for a CSI-RS resource to be measured is defined as

- Ntotal / Noutside\_MG in FR1

- Psharing factor \* Ntotal / Noutside\_MG in FR2 with Navailable = 0

- Ntotal / Navailable in FR2 with Navailable > 0

- For a window W of duration max(TL1, xRP\_max), where xRP\_max is the maximum xRP across all configured per-UE measurement gaps or NCSGs, MUSIM gap(s)and per-FR measurement gaps or NCSGs, and, in case of Pre-MG, all activated per-UE measurement gaps and per-FR measurement gaps, within the same FR as serving cell, and starting at the beginning of any CSI-RS resource occasion:

- Ntotal is the total number of CSI-RS resource occasions within the window W, including those overlapped with measurement gap occasions, MUSIM gap occasions or SMTC occasions within the window W, and

- Noutside\_MG is the number of CSI-RS resource occasions that are not overlapped with any non-dropped GAP occasions nor non-dropped MUSIM gap occasion within the window W, and

- Navailable is the number of CSI-RS resource occasions that are not overlapped with any non-dropped GAP occasions, non-dropped MUSIM gap occasion nor any SMTC occasion within the window W.

- a CSI-RS or an SMTC occasion is considered to be overlapped with the MUSIM gap if it overlaps a MUSIM gap occasion.

- xRP = MGRP when configured GAP is activated Pre-MG or MG, and xRP = VIRP when configured GAP is NCSG.

TL1 is periodicity of the target CSI-RS.

Otherwise, for a UE neither supporting *concurrentMeasGap-r17* nor *[support for Case 1 requirements]* nor *[support for Case 2 requirements]* or when neither of the above configurations applies, i.e. concurrent measurement gaps, concurrent measurement gap(s) with Pre-MG(s) and concurrent measurement gap(s) with NCSG measurement gap(s), and UE does not support *musim-GapPreference-r17* or when no MUSIM gaps are configured.

For FR1,

- P=$\frac{1}{1-\frac{T\_{CSI-RS}}{xRP}}$, when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the CSI-RS; and

- P=1 when in the monitored cell there are no GAPs overlapping with any occasion of the CSI-RS.

For FR2,

- P=1, when CSI-RS is not overlapped with a GAP and also not overlapped with SMTC occasion.

- P=$\frac{1}{1-\frac{T\_{CSI-RS}}{xRP}}$, when CSI-RS is partially overlapped with GAP and CSI-RS is not overlapped with SMTC occasion (TCSI-RS < xRP)

- P=$\frac{1}{1-\frac{T\_{CSI-RS}}{T\_{SMTCperiod}}}$, when CSI-RS is not overlapped with GAP and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P=Psharing factor, when CSI-RS is not overlapped with GAP and CSI-RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- P=1, when aperiodic CSI-RS resource is not overlapped with GAP

- P=$ \frac{1}{1-\frac{T\_{CSI-RS}}{xRP}-\frac{T\_{CSI-RS}}{T\_{SMTCperiod}}}$, when CSI-RS is partially overlapped with GAP and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TCSI-RS < 0.5\*TSMTCperiod

- P=$\frac{3}{1-\frac{T\_{CSI-RS}}{xRP}}$, when CSI-RS is partially overlapped with GAP and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TCSI-RS = 0.5\*TSMTCperiod

- P=$ \frac{1}{1-\frac{T\_{CSI-RS}}{min⁡(T\_{SMTCperiod},xRP)}}$, when CSI-RS is partially overlapped with GAP (TCSI-RS < xRP) and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP.

- P=$\frac{P\_{sharing factor}}{1-\frac{T\_{CSI-RS}}{xRP}}$, when CSI-RS is partially overlapped with GAP and CSI-RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

Where:

- Psharing factor = 1, if the CSI-RS configured for L1-RSRP measurement outside gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

TSMTCperiod = the configured SMTC period.

 TCSI-RS = the periodicity of CSI-RS configured for L1-RSRP measurement

- When a measurement gap is configured and the measurement gap is not NCSG,

- a CSI-RS or an SMTC occasion is considered to be as overlapped with the GAP if it overlapps a measurement gap occasion, and

- xRP = MGRP

- If the UE is configured with Pre-MG, a CSI-RS or an SMTC occasion is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- Otherwise, when NCSG measurement gap only is configured,

- a CSI-RS or an SMTC occasion is considered to be as overlapped with the GAP if

- it overlaps the VIL1 or VIL2 of NCSG, or

- it overlaps the ML of NCSG in FR2, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell,

- and

- xRP = VIRP

When UE is configured with aperiodic MUSIM gap and the aperiodic MUSIM gap is overlapping with CSI-RS resource occasion for L1-RSRP, longer evaluation period would be expected.

When UE is configured with MUSIM gap(s), and CSI-RS resource occasions for L1-RSRP are fully overlapped with MUSIM gap(s) or fully overlapped with the union of MUSIM gap(s) and GAPs, no requirement applies for the CSI-RS based L1-RSRP measurement.

Table 9.5.4.2-1: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS for FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS (ms)  |
| non-DRX | max(TReport, ceil((M+L1)\*P)\* max(TCSI-RS, Tproc)) |
| DRX cycle ≤ 320 ms | max(TReport, ceil(K \*(M+L1)\*P)\*max(TDRX,TCSI-RS, Tproc)) |
| DRX cycle > 320 ms | ceil((M+L1)\*P)\*TDRX |
| NOTE 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.NOTE 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3.NOTE 3: K = 1 when TCSI-RS ≤ 40 ms and *highSpeedMeasFlag-r16 or highSpeedMeasCA-Scell-r17* are configured; otherwise K = 1.5.NOTE 4: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16 or measurementEnhancementCA-r17.*NOTE 5: If UE indicates *needForScaledCSIProcTimeDualDL* and the CSI-RS resource for CMR is across 2 DL subbands, Tproc = 8ms; otherwise Tproc = 0. |

Table 9.5.4.2-2: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS for FR2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS (ms)  |
| non-DRX | max(TReport, ceil((M+L1)\*P\*N)\* max(TCSI-RS, Tproc) |
| DRX cycle ≤ 320 ms | max(TReport, ceil(1.5\*(M+L1)\*P\*N)\*max(TDRX,TCSI-RS, Tproc)) |
| DRX cycle > 320 ms | ceil((M+L1)\*P\*N)\*TDRX |
| NOTE 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.NOTE 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3.NOTE 5: If UE indicates *needForScaledCSIProcTimeDualDL* and the CSI-RS resource for CMR is across 2 DL subbands, Tproc = 8ms; otherwise Tproc = 0. |

Table 9.5.4.2-2A: Void

<End of Change 1>