**3GPP TSG-RAN WG2 Meeting #127 *R2-240xxxx***

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  |  | **CR** | **xxxx** | **rev** |  | **Current version:** |  |  |
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| *For* [***HELP***](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 | **x** | Core Network |  |

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| ***Title:*** | Correction to PHR for multi-TRP multi-panel scheme in MIMO Evolution | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Samsung | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_MIMO\_evo\_DL\_UL-Core | | | | |  | ***Date:*** | | | 2024-08-30 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | F |  | | | | | ***Release:*** | | | Rel-18 |
|  | *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 can be 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:*** | | 1. For a serving cell configured with multiple TRP PUSCH repetition or multipanelSchemeSDM or multipanelSchemeSFN, it is not clear whether type 3 PH can be reported. The correction is made according to the following RAN2 agreement based on RAN1 LS reply R2-2406214.  This CR implements the following agreements   * In PHR procedure, type 3 PH is not reported for serving cell configured with multiple TRP PUSCH repetition or multipanelSchemeSDM or multipanelSchemeSFN. Remove type 3 PH at two places in the above MAC procedural text.   2. If the MAC entity transmitting the PHR MAC CE is not configured with twoPHRmode and a serving cell belonging to the other MAC entity configured with twoPHRmode is configured with multipanelSchemeSDM or multipanelSchemeSFN, UE reports only one type 1 PH. However, it is not clear the type 1 PH for which PUSCH transmission is reported when there are two PUSCH transmissions in multi-panel scheme. The correction is made according to the following RAN2 agreement.   * The following is agreed and the exact change to MAC spec can be further checked. Can revisit if R1 agreed otherwise.   **For mTRP STx2P, if twoPHRmode is not configured,**   * **if there is at least a real PUSCH transmission,**    + **if the first TCI state is applied for a real PUSCH transmission, UE obtains the type 1 PH and the Pcmax associated with the first TCI state;**   + **else UE obtains the type 1 PH and the Pcmax associated with the second TCI state.** * **else if there is no real PUSCH transmission, UE obtains the type 1 PH and the Pcmax associated with the first TCI state.** | | | | | | | | |
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| ***Summary of change:*** | | 1. In clause 5.4.6, remove type 3 PH for serving cell configured with multiple TRP PUSCH repetition or multipanelSchemeSDM or multipanelSchemeSFN. 2. In clause 5.4.6, introduce a separate description for how the UE obtains a single type 1 PH value for serving cells configured with *multipanelSchemeSDM* or *multipanelSchemeSFN*.   **Impact analysis**  Impacted 5G architecture options:  NR DC  Impacted functionality:  MIMO multi-TRP STx2P    Interoperability:  For change 1:  If the NW implements this CR but not the UE, there might be no operability issue because NW by configuration can avoid the case for which type 3 PH is reported.  If the UE implements this CR but not the NW, there is no operability issue.  For change 2:  If the NW implements this CR but not the UE, UE does not know how to report a single PH if the MAC entity transmitting the PHR MAC CE is not configured with twoPHRmode and a serving cell belonging to other MAC entity configured with twoPHRmode is configured with multipanelSchemeSDM or multipanelSchemeSFN.  If the UE implements this CR but not the NW, there is no operability issue. | | | | | | | | |
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| ***Consequences if not approved:*** | | For PHR in multi-TRP STx2P multi-panel scheme introduced in MIMOevo of Release-18, it is not clear how to report a single PH value in case there are two real PUSCH transmissions or no real transmission. | | | | | | | | |
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| ***Clauses affected:*** | | 5.4.6 | | | | | | | | |
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|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **N** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **n** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **n** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

### 5.4.6 Power Headroom Reporting

The Power Headroom reporting procedure is used to provide the serving gNB with the following information:

- Type 1 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH transmission per activated Serving Cell;

- Type 2 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH and PUCCH transmission on SpCell of the other MAC entity (i.e. E-UTRA MAC entity in EN-DC, NE-DC, and NGEN-DC cases);

- Type 3 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for SRS transmission per activated Serving Cell;

- MPE P-MPR: the power backoff to meet the MPE FR2 requirements for a Serving Cell operating on FR2;

- DPC: the adjustment to maximum output power for a given power class for a Serving Cell operating on FR1;

- DPCBC: the adjustment to maximum output power for a given power class for a Band Combination operating on FR1.

RRC controls Power Headroom reporting by configuring the following parameters:

- *dpc-Reporting-FR1*;

- *phr-AssumedPUSCH-Reporting*;

- *phr-PeriodicTimer*;

- *phr-ProhibitTimer*;

- *phr-Tx-PowerFactorChange*;

- *phr-Type2OtherCell*;

- *phr-ModeOtherCG*;

- *multiplePHR*;

- *mpe-Reporting-FR2*;

- *mpe-ProhibitTimer*;

- *mpe-Threshold*;

- *numberOfN*;

- *mpe-ResourcePoolToAddModList*;

- *twoPHRMode*.

A Power Headroom Report (PHR) shall be triggered if any of the following events occur:

- *phr-ProhibitTimer* expires or has expired and the path loss has changed more than *phr-Tx-PowerFactorChange* dB for at least one RS used as pathloss reference for one activated Serving Cell of any MAC entity of which the active DL BWP is not dormant BWP since the last transmission of a PHR in this MAC entity when the MAC entity has UL resources for new transmission;

NOTE 1: The path loss variation for one cell assessed above is between the pathloss measured at present time on the current pathloss reference and the pathloss measured at the transmission time of the last transmission of PHR on the pathloss reference in use at that time, irrespective of whether the pathloss reference has changed in between. The current pathloss reference for this purpose does not include any pathloss reference configured using *pathlossReferenceRS-Pos* in TS 38.331 [5].

- *phr-PeriodicTimer* expires;

- upon configuration or reconfiguration of the power headroom reporting functionality by upper layers, which is not used to disable the function;

- activation of an SCell of any MAC entity with configured uplink of which *firstActiveDownlinkBWP-Id* is not set to dormant BWP;

- activation of an SCG;

- addition of the PSCell except if the SCG is deactivated (i.e. PSCell is newly added or changed);

- *phr-ProhibitTimer* expires or has expired, when the MAC entity has UL resources for new transmission, and the following is true for any of the activated Serving Cells of any MAC entity with configured uplink:

- there are UL resources allocated for transmission or there is a PUCCH transmission on this cell, and the required power backoff due to power management (as allowed by P-MPRc as specified in TS 38.101-1 [14], TS 38.101-2 [15], and TS 38.101-3 [16]) for this cell has changed more than *phr-Tx-PowerFactorChange* dB since the last transmission of a PHR when the MAC entity had UL resources allocated for transmission or PUCCH transmission on this cell.

- Upon switching of activated BWP from dormant BWP to non-dormant DL BWP of an SCell of any MAC entity with configured uplink;

- if *dpc-Reporting-FR1* is configured, ΔPPowerClass /ΔPPowerClass, CA/ΔPPowerClass, EN-DC/ΔPPowerClass, NR-DC reporting is triggered upon uplink duty cycle exceedance or upon return to the power class after the duty cycle exceedance, as specified in TS 38.101-1 [14] and TS 38.101-3 [16]).

- if *mpe-Reporting-FR2* is configured, and *mpe-ProhibitTimer* is not running:

- the measured P-MPR applied to meet FR2 MPE requirements as specified in TS 38.101-2 [15] is equal to or larger than *mpe-Threshold* for at least one activated FR2 Serving Cell since the last transmission of a PHR in this MAC entity; or

- the measured P-MPR applied to meet FR2 MPE requirements as specified in TS 38.101-2 [15] has changed more than *phr-Tx-PowerFactorChange* dB for at least one activated FR2 Serving Cell since the last transmission of a PHR due to the measured P-MPR applied to meet MPE requirements being equal to or larger than *mpe-Threshold* in this MAC entity.

in which case the PHR is referred below to as 'MPE P-MPR report'.

NOTE 2: The MAC entity should avoid triggering a PHR when the required power backoff due to power management decreases only temporarily (e.g. for up to a few tens of milliseconds) and it should avoid reflecting such temporary decrease in the values of PCMAX,f,c/PH when a PHR is triggered by other triggering conditions.

NOTE 3: If a HARQ process is configured with *cg-RetransmissionTimer* and if the PHR is already included in a MAC PDU for transmission on configured grant by this HARQ process, but not yet transmitted by lower layers, it is up to UE implementation how to handle the PHR content.

If the MAC entity has UL resources allocated for a new transmission the MAC entity shall:

1> if it is the first UL resource allocated for a new transmission since the last MAC reset:

2> start *phr-PeriodicTimer*.

1> if the Power Headroom reporting procedure determines that at least one PHR has been triggered and not cancelled; and

1> if the allocated UL resources can accommodate the MAC CE for PHR which the MAC entity is configured to transmit, plus its subheader, as a result of LCP as defined in clause 5.4.3.1:

2> if *multiplePHR* with value *true* is configured:

3> for each activated Serving Cell with configured uplink associated with any MAC entity of which the active DL BWP is not dormant BWP; and

3> for each activated Serving Cell with configured uplink associated with E-UTRA MAC entity:

4> if this MAC entity is configured with *twoPHRMode*:

5> if this Serving Cell is configured with *multipanelSchemeSDM* or *multipanelSchemeSFN* and the MAC entity this Serving Cell belongs to is configured with *twoPHRMode*:

6> obtain two values of the Type 1 power headroom for the corresponding uplink carrier as specified in clause 7.7 of TS 38.213 [6] for NR Serving Cell.

5> else if this Serving Cell is configured with multiple TRP PUSCH repetition (i.e., not configured with *multipanelSchemeSDM* or *multipanelSchemeSFN*) and the MAC entity this Serving Cell belongs to is configured with *twoPHRMode*:

6> obtain two values of the Type 1 power headroom for the corresponding uplink carrier as specified in clause 7.7 of TS 38.213 [6] for NR Serving Cell.

5> else:

6> obtain the value of the Type 1 or Type 3 power headroom for the corresponding uplink carrier as specified in clause 7.7 of TS 38.213 [6] for NR Serving Cell and clause 5.1.1.2 of TS 36.213 [17] for E-UTRA Serving Cell.

4> else (i.e. this MAC entity is not configured with *twoPHRMode*):

5> if this Serving Cell is configured with multiple TRP PUSCH repetition or *multipanelSchemeSDM* or *multipanelSchemeSFN* and if the MAC entity this Serving Cell belongs to is configured with *twoPHRMode*:

6> if there is at least one real PUSCH transmission at the slot where the PHR MAC CE is transmitted:

7> if this Serving Cell is configured with *multipanelSchemeSDM* or *multipanelSchemeSFN*:

8> if the first *TCI-State* or *TCI-UL-State* is applied for a real PUSCH transmission:

9> obtain the value of the Type 1 power headroom of the real PUSCH transmission associated with the first *TCI-State* or *TCI-UL-State* for the corresponding uplink carrier as specified in clause 7.7 of TS 38.213[6] for NR Serving Cell.

8> else:

9> obtain the value of the Type 1 power headroom of the real PUSCH transmission associated with the second *TCI-State* or *TCI-UL-State* for the corresponding uplink carrier as specified in clause 7.7 of TS 38.213[6] for NR Serving Cell.

7> else if this Serving Cell is configured with multiple TRP PUSCH repetition:

8> obtain the value of the Type 1 power headroom of the first real transmission of the corresponding uplink carrier as specified in clause 7.7 of TS 38.213[6] for NR Serving Cell.

6> else if there is no real PUSCH transmission at the slot where the PHR MAC CE is transmitted:

7> if this Serving Cell is configured with *multipanelSchemeSDM* or *multipanelSchemeSFN*:

8> obtain the value of the Type 1 power headroom of the reference PUSCH transmission associated with the first *TCI-State* or *TCI-UL-State* for the corresponding uplink carrier as specified in clause 7.7 of TS 38.213[6] for NR Serving Cell.

7> else if this Serving Cell is configured with multiple TRP PUSCH repetition:

8> obtain the value of the Type 1 power headroom of the reference PUSCH transmission associated with the *SRS-ResourceSet* with a lower *SRS-resourceSetID* for the corresponding uplink carrier as specified in clause 7.7 of TS 38.213[6] for NR Serving Cell.

5> else:

6> obtain the value of the Type 1 or Type 3 power headroom for the corresponding uplink carrier as specified in clause 7.7 of TS 38.213 [6] for NR Serving Cell and clause 5.1.1.2 of TS 36.213 [17] for E-UTRA Serving Cell.

4> if this MAC entity is configured with *phr-AssumedPUSCH-Reporting*:

5> if this MAC entity has UL resources allocated for transmission on this Serving Cell; or

5> if the other MAC entity, if configured, has UL resources allocated for transmission on this Serving Cell and *phr-ModeOtherCG* is set to *real* by upper layers:

6> if *dynamicTransformPrecoderFieldPresenceDCI-0-1-r18* or *dynamicTransformPrecoderFieldPresenceDCI-0-2-r18* is set to *enabled* in the active BWP of this Serving Cell:

7> obtain the value for the corresponding PCMAX,f,c field for assumed PUSCH from the physical layer if available, as specified in clause 7.7 of TS 38.213 [6].

6> obtain the value for the corresponding PCMAX,f,c field from the physical layer.

6> if *mpe-Reporting-FR2* is configured and this Serving Cell operates on FR2 and this Serving Cell is associated to this MAC entity:

7> obtain the value for the corresponding MPE field from the physical layer.

4> else (i.e. if this MAC entity is not configured with *phr-AssumedPUSCH-Reporting*):

5> if this MAC entity is configured with *twoPHRMode* and if this Serving Cell is configured with *multipanelSchemeSDM* or *multipanelSchemeSFN*:

6> obtain two values for the corresponding PCMAX,f,c,k fields from the physical layer.

6> if *mpe-Reporting-FR2* is configured and this Serving Cell operates on FR2 and this Serving Cell is associated to this MAC entity:

7> obtain two values for the corresponding MPEk fields from the physical layer.

5> else:

6> if this MAC entity has UL resources allocated for transmission on this Serving Cell; or

6> if the other MAC entity, if configured, has UL resources allocated for transmission on this Serving Cell and *phr-ModeOtherCG* is set to *real* by upper layers:

7> obtain the value for the corresponding PCMAX,f,c field from the physical layer.

7> if *mpe-Reporting-FR2* is configured and this Serving Cell operates on FR2 and this Serving Cell is associated to this MAC entity:

8> obtain the value for the corresponding MPE field from the physical layer.

7> if *mpe-Reporting-FR2-r17* is configured and this Serving Cell operates on FR2 and this Serving Cell is associated to this MAC entity:

8> obtain the value for the corresponding MPEi field from the physical layer;

8> obtain the value for the corresponding Resourcei field from the physical layer.

7> if *dpc-Reporting-FR1* is configured and ΔPPowerClass /ΔPPowerClass, CA/ΔPPowerClass, EN-DC/ΔPPowerClass, NR-DC reporting is triggered and this Serving Cell operates on FR1 and this Serving Cell is associated to this MAC entity:

8> obtain the value for the corresponding DPC field(s) from the physical layer.

3> if *phr-Type2OtherCell* with value *true* is configured:

4> if the other MAC entity is E-UTRA MAC entity:

5> obtain the value of the Type 2 power headroom for the SpCell of the other MAC entity (i.e. E-UTRA MAC entity);

5> if *phr-ModeOtherCG* is set to *real* by upper layers:

6> obtain the value for the corresponding PCMAX,f,c field for the SpCell of the other MAC entity (i.e. E-UTRA MAC entity) from the physical layer.

3> if this MAC entity is configured with *mpe-Reporting-FR2-r17*:

4> instruct the Multiplexing and Assembly procedure to generate and transmit the Enhanced Multiple entry PHR as defined in clause 6.1.3.49 based on the values reported by the physical layer.

3> else if this MAC entity is configured with *twoPHRMode* and any associated Serving Cell is configured with *multipanelSchemeSDM* or *multipanelSchemeSFN*:

4> instruct the Multiplexing and Assembly procedure to generate and transmit the Enhanced Multiple Entry PHR for multiple TRP STx2P MAC CE as defined in clause 6.1.3.82 based on the values reported by the physical layer.

3> else if this MAC entity is configured with *twoPHRMode* and any associated Serving Cell is configured with multiple TRP PUSCH repetition:

4> instruct the Multiplexing and Assembly procedure to generate and transmit the Enhanced Multiple Entry PHR for multiple TRP MAC CE as defined in clause 6.1.3.51 based on the values reported by the physical layer.

3> else if this MAC entity is configured with *phr-AssumedPUSCH-Reporting*:

4> instruct the Multiplexing and Assembly procedure to generate and transmit the Multiple Entry PHR with assumed PUSCH MAC CE as defined in clause 6.1.3.79 based on the values reported by the physical layer.

3> else:

4> instruct the Multiplexing and Assembly procedure to generate and transmit the Multiple Entry PHR MAC CE as defined in clause 6.1.3.9 based on the values reported by the physical layer.

2> else (i.e. Single Entry PHR format is used):

3> if this MAC entity is configured with *twoPHRMode* for multiple TRP PUSCH repetition or *multipanelSchemeSDM* or *multipanelSchemeSFN*:

4> obtain two values of the Type 1 power headroom from the physical layer for the corresponding uplink carrier of the PCell.

3> else:

4> obtain the value of the Type 1 power headroom from the physical layer for the corresponding uplink carrier of the PCell.

3> if this MAC entity is configured with *phr-AssumedPUSCH-Reporting*:

4> if *dynamicTransformPrecoderFieldPresenceDCI-0-1-r18* or *dynamicTransformPrecoderFieldPresenceDCI-0-2-r18* is set to *enabled* in the active BWP of this Serving Cell:

5> obtain the value for the corresponding PCMAX,f,c field for assumed PUSCH from the physical layer, if available, as specified in clause 7.7 of TS 38.213 [6].

3> if this MAC entity is configured with *twoPHRMode* and if this Serving Cell is configured with *multipanelSchemeSDM* or *multipanelSchemeSFN*:

4> obtain two values for the corresponding PCMAX,f,c,k fields from the physical layer.

4> if *mpe-Reporting-FR2* is configured and this Serving Cell operates on FR2 and this Serving Cell is associated to this MAC entity:

5> obtain two values for the corresponding MPEk fields from the physical layer.

3> else:

4> obtain the value for the corresponding PCMAX,f,c field from the physical layer;

4> if *mpe-Reporting-FR2* is configured and this Serving Cell operates on FR2:

5> obtain the value for the corresponding MPE field from the physical layer.

4> if *mpe-Reporting-FR2-r17* is configured and this Serving Cell operates on FR2 and this Serving Cell is associated to this MAC entity:

5> obtain the value for the corresponding MPEi field from the physical layer;

5> obtain the value for the corresponding Resourcei field from the physical layer.

4> if *dpc-Reporting-FR1* is configured and this Serving Cell operates on FR1:

5> obtain the value for the corresponding DPC field from the physical layer.

3> if this MAC entity is configured with *mpe-Reporting-FR2-r17*:

4> instruct the Multiplexing and Assembly procedure to generate and transmit the Enhanced Single entry PHR as defined in clause 6.1.3.48 based on the values reported by the physical layer.

3> else if this MAC entity is configured with *twoPHRMode* and this Serving Cell is configured with *multipanelSchemeSDM* or *multipanelSchemeSFN*:

4> instruct the Multiplexing and Assembly procedure to generate and transmit the Enhanced Single Entry PHR for multiple TRP STx2P MAC CE as defined in clause 6.1.3.81 based on the values reported by the physical layer.

3> else if this MAC entity is configured with *twoPHRMode* and this Serving Cell is configured with multiple TRP PUSCH repetition:

4> instruct the Multiplexing and Assembly procedure to generate and transmit the Enhanced Single Entry PHR for multiple TRP MAC CE as defined in clause 6.1.3.50 based on the values reported by the physical layer.

3> else if this MAC entity is configured with *phr-AssumedPUSCH-Reporting*:

4> instruct the Multiplexing and Assembly procedure to generate and transmit the Single Entry PHR with assumed PUSCH MAC CE as defined in clause 6.1.3.78 based on the values reported by the physical layer.

3> else:

4> instruct the Multiplexing and Assembly procedure to generate and transmit the Single Entry PHR MAC CE as defined in clause 6.1.3.8 based on the values reported by the physical layer.

2> if this PHR report is an MPE P-MPR report:

3> start or restart the *mpe-ProhibitTimer*;

3> cancel triggered MPE P-MPR reporting for Serving Cells included in the PHR MAC CE.

2> start or restart *phr-PeriodicTimer*;

2> start or restart *phr-ProhibitTimer*;

2> cancel all triggered PHR(s).

All triggered PHRs shall be cancelled when there is an ongoing SDT procedure as in clause 5.27 and the UL grant(s) can accommodate all pending data available for transmission but is not sufficient to additionally accommodate the PHR MAC CE plus its subheader.