**3GPP TSG- Meeting #**

**, , 20 – 24. May 2024**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
|  |
|  |  | **CR** |  | **rev** |  | **Current version:** |  |  |
|  |
| *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 | **x** | Core Network |  |

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|  |
| ***Title:***  | Draft CR for 38.213 for capturing NR over NTN operation  |
|  |  |
| ***Source to WG:*** |  |
| ***Source to TSG:*** | R1 |
|  |  |
| ***Work item code:*** | NR\_NTN\_solutions-Core |  | ***Date:*** |  |
|  |  |  |  |  |
| ***Category:*** |  |  | ***Release:*** | 7 |
|  | *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)* |
|  |  |
| ***Reason for change:*** | Current Rel-17 specifications does not contain references to the TS 38.101-5 (which defines frequency bands and requirements for these). Without these, it is not possible to extract e.g. frequency bands, UE Tx power control limits, etc. |
|  |  |
| ***Summary of change:*** | Update of refences to capture operation of NR over NTN for Rel-17 |
|  |  |
| ***Consequences if not approved:*** | Rel-17 NR over NTN will not be implementable. |
|  |  |
| ***Clauses affected:*** | 2, 4.1, 7.1.1, 7.2.1, 7.3.1, 7.4, 7.7.1, 7.7.3, 18 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 38.211 |
| ***affected:*** |  | **x** |  Test specifications |  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications |  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

**<Unchanged parts omitted>**

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications"

[2] 3GPP TS 38.201: "NR; Physical Layer – General Description"

[3] 3GPP TS 38.202: "NR; Services provided by the physical layer"

[4] 3GPP TS 38.211: "NR; Physical channels and modulation"

[5] 3GPP TS 38.212: "NR; Multiplexing and channel coding"

[6] 3GPP TS 38.214: "NR; Physical layer procedures for data"

[7] 3GPP TS 38.215: "NR; Physical layer measurements"

[8-1] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone"

[8-2] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone"

[8-3] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios"

[8-4] 3GPP TS 38.101-4: "NR; User Equipment (UE) radio transmission and reception; Part 4: Performance requirements"

[8-5] 3GPP TS 38.101-5: "NR; User Equipment (UE) radio transmission and reception; Part 5: Satellite access Radio Frequency (RF) and performance requirements"

[9] 3GPP TS 38.104: "NR; Base Station (BS) radio transmission and reception"

[10] 3GPP TS 38.133: "NR; Requirements for support of radio resource management"

[11] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification"

[12] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification"

**<Unchanged parts omitted>**

## 4.1 Cell search

Cell search is the procedure for a UE to acquire time and frequency synchronization with a cell and to detect the physical layer Cell ID of the cell.

A UE receives the following synchronization signals (SS) in order to perform cell search: the primary synchronization signal (PSS) and secondary synchronization signal (SSS) as defined in [4, TS 38.211].

A UE assumes that reception occasions of a physical broadcast channel (PBCH), PSS, and SSS are in consecutive symbols, as defined in [4, TS 38.211], and form a SS/PBCH block. The UE assumes that SSS, PBCH DM-RS, and PBCH data have same EPRE. The UE may assume that the ratio of PSS EPRE to SSS EPRE in a SS/PBCH block is either 0 dB or 3 dB. If the UE has not been provided dedicated higher layer parameters, the UE may assume that the ratio of PDCCH DMRS EPRE to SSS EPRE is within -8 dB and 8 dB when the UE monitors PDCCHs for a DCI format 1\_0 with CRC scrambled by SI-RNTI, P-RNTI, or RA-RNTI, or for a DCI format 2\_7, or for a DCI format 4\_0.

For a half frame with SS/PBCH blocks, the first symbol indexes for candidate SS/PBCH blocks are determined according to the SCS of SS/PBCH blocks as follows, where index 0 corresponds to the first symbol of the first slot in a half-frame.

- Case A - 15 kHz SCS: the first symbols of the candidate SS/PBCH blocks have indexes of $\left\{2,8\right\}+14⋅n$.

- For operation without shared spectrum channel access:

- For carrier frequencies smaller than or equal to 3 GHz, $n=0,1$.

- For carrier frequencies within FR1 larger than 3 GHz, $n=0,1,2,3$.

- For operation with shared spectrum channel access, as described in [15, TS 37.213], $n=0, 1, 2, 3, 4$.

- Case B - 30 kHz SCS: the first symbols of the candidate SS/PBCH blocks have indexes $\left\{4,8,16,20\right\}+28⋅n$. For carrier frequencies smaller than or equal to 3 GHz, $n=0$. For carrier frequencies within FR1 larger than 3 GHz, $n=0,1$.

- Case C - 30 kHz SCS: the first symbols of the candidate SS/PBCH blocks have indexes $\left\{2,8\right\}+14⋅n$.

- For operation without shared spectrum channel access

- For paired spectrum operation

- For carrier frequencies smaller than or equal to 3 GHz, $n=0,1$. For carrier frequencies within FR1 larger than 3 GHz, $n=0,1,2,3$.

- For unpaired spectrum operation

- For carrier frequencies smaller than 1.88 GHz, $n=0,1$. For carrier frequencies within FR1 equal to or larger than 1.88 GHz, $n=0,1,2,3$.

- For operation with shared spectrum channel access, $n=0, 1, 2, 3, 4, 5, 6, 7, 8, 9$.

- Case D - 120 kHz SCS: the first symbols of the candidate SS/PBCH blocks have indexes $\left\{4,8,16,20\right\}+28⋅n$. For carrier frequencies within FR2, $n=0, 1, 2, 3, 5, 6, 7, 8, 10, 11, 12, 13, 15, 16, 17, 18$.

- Case E - 240 kHz SCS: the first symbols of the candidate SS/PBCH blocks have indexes $\left\{8,12,16,20,32,36,40,44\right\}+56⋅n$. For carrier frequencies within FR2-1, $n=0, 1, 2, 3, 5, 6, 7, 8$.

- Case F – 480 kHz SCS: the first symbols of the candidate SS/PBCH blocks have indexes $\left\{2, 9\right\}+14⋅n$. For carrier frequencies within FR2-2, $n=0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31.$

- Case G – 960 kHz SCS: the first symbols of the candidate SS/PBCH blocks have indexes $\left\{2, 9\right\}+14⋅n$. For carrier frequencies within FR2-2, $n=0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31.$

From the above cases, if the SCS of SS/PBCH blocks is not provided by *ssbSubcarrierSpacing*, the applicable cases for a cell depend on a respective frequency band, as provided in [8-1, TS 38.101-1], [8-2, TS 38.101-2], and [8-5, TS 38.101-5]. A same case applies for all SS/PBCH blocks on the cell. If a 30 kHz SS/PBCH block SCS is indicated by *ssbSubcarrierSpacing*, Case B applies for frequency bands with only 15 kHz SS/PBCH block SCS as specified in [8-1, TS 38.101-1] and [8-5, TS 38.101-5], and the case specified for 30 kHz SS/PBCH block SCS in [8-1, TS 38.101-1] and [8-5, TS 38.101-5] applies for frequency bands with 30 kHz SS/PBCH block SCS or both 15 kHz and 30 kHz SS/PBCH block SCS as specified in [8-1, TS 38.101-1] and [8-5, TS 38.101-5]. For a UE configured to operate with carrier aggregation over a set of cells in a frequency band of FR2 or with frequency-contiguous carrier aggregation over a set of cells in a frequency band of FR1, if the UE is provided SCS values by *ssbSubcarrierSpacing* for receptions of SS/PBCH blocks on any cells from the set of cells, the UE expects the SCS values to be same.

The candidate SS/PBCH blocks in a half frame are indexed in an ascending order in time from 0 to $\overline{L}\_{max}-1$, where $\overline{L}\_{max}$ is determined according to SS/PBCH block patterns for Cases A through G. $L\_{max}$ is a maximum number of SS/PBCH block indexes in a cell, and the maximum number of transmitted SS/PBCH blocks within a half frame is $L\_{max}$.

**<Unchanged parts omitted>**

### 7.1.1 UE behaviour

If a UE transmits a PUSCH on active UL BWP $b$ of carrier $f$ of serving cell $c$ using parameter set configuration with index $j$ and PUSCH power control adjustment state with index $l$, the UE determines the PUSCH transmission power $P\_{PUSCH,b,f,c}(i,j,q\_{d},l)$ in PUSCH transmission occasion $i$ as

 [dBm]

where,

- $P\_{CMAX,f,c}(i)$is the UE configured maximum output power defined in [8-1, TS 38.101-1], [8-2, TS 38.101-2], [8-3, TS 38.101-3], and [8-5, TS 38.101-5] for carrier $f$ of serving cell $c$ in PUSCH transmission occasion $i$.

- $P\_{O\\_PUSCH,b,f,c}(j)$ is a parameter composed of the sum of a component $P\_{O\\_NOMINAL,PUSCH,f,c}(j)$ and a component $P\_{O\\_UE\\_PUSCH,b,f,c}(j)$ where $j\in \left\{0,1,…,J-1\right\}$.

- If a UE established dedicated RRC connection using a Type-1 random access procedure, as described in clause 8, and is not provided *P0-PUSCH-AlphaSet* or for a PUSCH (re)transmission corresponding to a RAR UL grant as described in clause 8.3,

**<Unchanged parts omitted>**

### 7.2.1 UE behaviour

If a UE transmits a PUCCH on active UL BWP $b$ of carrier $f$ in the primary cell $c$ using PUCCH power control adjustment state with index $l$, the UE determines the PUCCH transmission power $P\_{PUCCH,b,f,c}(i,q\_{u},q\_{d},l)$ in PUCCH transmission occasion $i$ as

 [dBm]

where

- $P\_{CMAX,f,c}(i)$ is the UE configured maximum output power defined in [8-1, TS 38.101-1], [8-2, TS 38.101-2], [8-3, TS 38.101-3], and [8-5, TS 38.101-5] for carrier $f$ of primary cell $c$ in PUCCH transmission occasion $i$

- $P\_{O\\_PUCCH,b,f,c}(q\_{u})$ is a parameter composed of the sum of a component $P\_{O\\_NOMINAL,PUCCH}$, provided by *p0-nominal*, or $P\_{O\\_NOMINAL,PUCCH}=0$ dBm if *p0-nominal* is not provided, for carrier $f$ of primary cell $c$ and, if provided, a component $P\_{O\\_UE\\_PUCCH}(q\_{u})$ provided by *p0-PUCCH-Value* in *P0-PUCCH* for active UL BWP $b$ of carrier $f$ of primary cell $c$, where $0\leq q\_{u}<Q\_{u}$. $Q\_{u}$ is a size for a set of $P\_{O\\_UE\\_PUCCH}$ values provided by *maxNrofPUCCH-P0-PerSet*. The set of $P\_{O\\_UE\\_PUCCH}$ values is provided by *p0-Set*. If *p0-Set* is not provided to the UE, $P\_{O\\_PUCCH,b,f,c}\left(q\_{u}\right)=0$, $0\leq q\_{u}<Q\_{u}$

**<Unchanged parts omitted>**

### 7.3.1 UE behaviour

If a UE transmits SRS based on a configuration by *SRS-ResourceSet* on active UL BWP $b$ of carrier $f$ of serving cell $c$ using SRS power control adjustment state with index $l$, the UE determines the SRS transmission power $P\_{SRS,b,f,c}(i,q\_{s},l)$ in SRS transmission occasion $i$ as

 [dBm]

where,

- $P\_{CMAX,f,c}(i)$ is the UE configured maximum output power defined in [8, TS 38.101-1], [8-2, TS 38.101-2], [TS 38.101-3], and [8-5, TS 38.101-5] for carrier $f$ of serving cell $c$ in SRS transmission occasion $i$

- $P\_{O\\_SRS,b,f,c}(q\_{s})$ is provided by *p0* for active UL BWP $b$ of carrier $f$ of serving cell $c$ and SRS resource set $q\_{s}$ provided by *SRS-ResourceSet* and *SRS-ResourceSetId*

- $M\_{SRS,b,f,c}(i)$ is a SRS bandwidth expressed in number of resource blocks for SRS transmission occasion $i$on active UL BWP $b$ of carrier $f$ of serving cell$c$ and $μ$ is a SCS configuration defined in [4, TS 38.211]

**<Unchanged parts omitted>**

## 7.4 Physical random access channel

A UE determines a transmission power for a physical random access channel (PRACH), , on active UL BWP  of carrier  of serving cell  based on DL RS for serving cell  in transmission occasion  as

  [dBm],

where  is the UE configured maximum output power defined in [8-1, TS 38.101-1], [8-2, TS 38.101-2], [8-3, TS 38.101-3], and [8-5, TS 38.101-5] for carrier  of serving cell  within transmission occasion ,  is the PRACH target reception power *PREAMBLE\_RECEIVED\_TARGET\_POWER* provided by higher layers [11, TS 38.321] for the active UL BWP  of carrier  of serving cell , and  is a pathloss for the active UL BWP  of carrier  based on the DL RS associated with the PRACH transmission on the active DL BWP of serving cell  and calculated by the UE in dB as *referenceSignalPower* – higher layer filtered RSRP in dBm, where RSRP is defined in [7, TS 38.215] and the higher layer filter configuration is defined in [12, TS 38.331]. If the active DL BWP is the initial DL BWP and for SS/PBCH block and CORESET multiplexing pattern 2 or 3, as described in clause 13, the UE determines  based on the SS/PBCH block associated with the PRACH transmission.

**<Unchanged parts omitted>**

### 7.7.1 Type 1 PH report

If a UE determines that a Type 1 power headroom report for an activated serving cell is based on an actual PUSCH transmission then, for PUSCH transmission occasion $i$ on active UL BWP $b$ of carrier $f$ of serving cell $c$, the UE computes the Type 1 power headroom report as

 [dB]

where $P\_{CMAX,f,c}(i)$, $P\_{O\\_PUSCH,b,f,c}(j)$, $M\_{RB,b,f,c}^{PUSCH}(i)$, $α\_{b,f,c}\left(j\right)$, $PL\_{b,f,c}(q\_{d})$, $∆\_{TF,b,f,c}\left(i\right)$ and $f\_{b,f,c}\left(i,l\right)$ are defined in clause 7.1.1.

If a UE is configured with multiple cells for PUSCH transmissions, where a SCS configuration $μ\_{1}$ on active UL BWP $b\_{1}$ of carrier $f\_{1}$ of serving cell $c\_{1}$ is smaller than a SCS configuration $μ\_{2}$ on active UL BWP $b\_{2}$ of carrier $f\_{2}$ of serving cell $c\_{2}$, and if the UE provides a Type 1 power headroom report in a PUSCH transmission in a slot on active UL BWP $b\_{1}$ that overlaps with multiple slots on active UL BWP $b\_{2}$, the UE provides a Type 1 power headroom report for the first PUSCH, if any, on the first slot of the multiple slots on active UL BWP $b\_{2}$ that fully overlaps with the slot on active UL BWP $b\_{1}$. If a UE is configured with multiple cells for PUSCH transmissions, where a same SCS configuration on active UL BWP $b\_{1}$ of carrier $f\_{1}$ of serving cell $c\_{1}$ and active UL BWP $b\_{2}$ of carrier $f\_{2}$ of serving cell $c\_{2}$, and if the UE provides a Type 1 power headroom report in a PUSCH transmission in a slot on active UL BWP $b\_{1}$, the UE provides a Type 1 power headroom report for the first PUSCH, if any, on the slot on active UL BWP $b\_{2}$ that overlaps with the slot on active UL BWP $b\_{1}$.

If a UE is configured with multiple cells for PUSCH transmissions and provides a Type 1 power headroom report in a PUSCH transmission with PUSCH repetition Type B having a nominal repetition that spans multiple slots on active UL BWP $b\_{1}$ and overlaps with one or more slots on active UL BWP $b\_{2}$, the UE provides a Type 1 power headroom report for the first PUSCH, if any, on the first slot of the one or more slots on active UL BWP $b\_{2}$ that overlaps with the multiple slots of the nominal repetition on active UL BWP $b\_{1}$.

For a UE configured with EN-DC/NE-DC and capable of dynamic power sharing, if E-UTRA Dual Connectivity PHR [14, TS 36.321] is triggered, the UE provides power headroom of the first PUSCH, if any, on the determined NR slot as described in clause 7.7.

If a UE is configured with multiple cells for PUSCH transmissions, the UE does not consider for computation of a Type 1 power headroom report in a first PUSCH transmission that includes an initial transmission of transport block on active UL BWP $b\_{1}$ of carrier $f\_{1}$ of serving cell $c\_{1}$, a second PUSCH transmission on active UL BWP $b\_{2}$ of carrier $f\_{2}$ of serving cell $c\_{2}$ that overlaps with the first PUSCH transmission if

- the second PUSCH transmission is scheduled by a DCI format in a PDCCH received in a second PDCCH monitoring occasion, and

- the second PDCCH monitoring occasion is after a first PDCCH monitoring occasion where the UE detects the earliest DCI format scheduling an initial transmission of a transport block after a power headroom report was triggered

or

- the second PUSCH transmission is after the first uplink symbol of the first PUSCH transmission minus *T'proc,2*=*Tproc,2* where *Tproc,2* is determined according to [6, TS 38.214] assuming *d2,1* =1, *d2,2*=0, and with *µDL* corresponding to the subcarrier spacing of the active downlink BWP of the scheduling cell for a configured grant if the first PUSCH transmission is on a configured grant after a power headroom report was triggered.

If the UE determines that a Type 1 power headroom report for an activated serving cell is based on a reference PUSCH transmission then, for PUSCH transmission occasion $i$ on active UL BWP $b$ of carrier $f$ of serving cell $c$, the UE computes the Type 1 power headroom report as

  [dB]

where $\tilde{P}\_{CMAX,f,c}(i)$ is computed assuming MPR=0 dB, A-MPR=0 dB, P-MPR=0 dB. TC = 0 dB. MPR, A-MPR, P-MPR and TC are defined in [8-1, TS 38.101-1], [8-2, TS 38.101-2], [8-3, TS 38.101-3], and [8-5, TS 38.101-5]. The remaining parameters are defined in clause 7.1.1 and, if *ul-powerControl* is not provided, $P\_{O\\_PUSCH,b,f,c}(j)$ and $α\_{b,f,c}\left(j\right)$ are obtained using $P\_{O\\_NOMINAL,PUSCH,f,c}\left(0\right)$ and *p0-PUSCH-AlphaSetId* *=* 0, $PL\_{b,f,c}(q\_{d})$ is obtained using *pusch-PathlossReferenceRS-Id =* 0, and $l=0$. If *ul-powerControl* is provided, $P\_{O\\_PUSCH,b,f,c}(j),$ $α\_{b,f,c}\left(j\right)$ and $l$ are obtained by *p0AlphaSetforPUSCH* associated with the indicated *TCI-State* or *TCI-UL-State*, $PL\_{b,f,c}(q\_{d})$ is obtained by PL-RS associated with the indicated *TCI-State* or *TCI-UL-State*. If the activated serving cell is an SCell and parameter *preambleReceivedTargetPower* is not configured for the cell, then the parameter *preambleReceivedTargetPower* configured for the primary cell is applied, where the parameter refers to the one configured for the non-supplementary uplink carrier if the primary cell is configured with two uplink carriers.

**<Unchanged parts omitted>**

### 7.7.3 Type 3 PH report

If a UE determines that a Type 3 power headroom report for an activated serving cell is based on an actual SRS transmission then, for SRS transmission occasion  on active UL BWP  of carrier  of serving cell $c$ and if the UE is not configured for PUSCH transmissions on carrier  of serving cell $c$ and the resource for the SRS transmission is provided by *SRS-Resource*, the UE computes a Type 3 power headroom report as

 [dB]

where , , , ,  and  are defined in clause 7.3.1 with corresponding values provided by *SRS-ResourceSet*.

If the UE determines that a Type 3 power headroom report for an activated serving cell is based on a reference SRS transmission then, for SRS transmission occasion  on UL BWP  of carrier  of serving cell $c$, and if the UE is not configured for PUSCH transmissions on UL BWP  of carrier  of serving cell $c$ and a resource for the reference SRS transmission is provided by *SRS-Resource*, the UE computes a Type 3 power headroom report as

  [dB]

where  is an SRS resource set corresponding to *SRS-ResourceSetId = 0* for UL BWP  and , ,  and  are defined in clause 7.3.1 with corresponding values obtained from *SRS-ResourceSetId = 0* for UL BWP .  is computed assuming MPR=0 dB, A-MPR=0 dB, P-MPR=0 dB and TC =0 dB. MPR, A-MPR, P-MPR and TC are defined in [8-1, TS 38.101-1], [8-2, TS 38.101-2], [8-3, TS 38.101-3] , and [8-5, TS 38.101-5].

If a UE is configured with two UL carriers for a serving cell and the UE determines a Type 3 power headroom report for the serving cell based on a reference SRS transmission and a resource for the reference SRS is provided by *SRS-Resource*, the UE computes a Type 3 power headroom report for the serving cell assuming a reference SRS transmission on the UL carrier provided by *pucch-Config*. If *pucch-Config* is not provided to the UE for any of the two UL carriers, the UE computes a Type 3 power headroom report for the serving cell assuming a reference SRS transmission on the non-supplementary UL carrier.

**<Unchanged parts omitted>**

# 18 Multicast Broadcast Services

This clause is applicable only for PDCCH receptions, PDSCH receptions, and PUCCH transmissions for MBS on a serving cell. DCI formats with CRC scrambled by G-RNTI for multicast or G-CS-RNTI scheduling PDSCH receptions are referred to as multicast DCI formats and the PDSCH receptions are referred to as multicast PDSCH receptions. DCI formats with CRC scrambled by MCCH-RNTI or G-RNTI for broadcast scheduling PDSCH receptions are referred to as broadcast DCI formats and the PDSCH receptions are referred to as broadcast PDSCH receptions. HARQ-ACK information associated with multicast DCI formats or multicast PDSCH receptions is referred to as multicast HARQ-ACK information.

A UE can be provided one or more G-RNTIs for multicast per serving cell for scrambling the CRC of multicast DCI formats for scheduling PDSCH receptions. The UE can be provided one or more G-CS-RNTI per serving cell for scrambling the CRC of multicast DCI formats providing activation/release/scheduling retransmission for SPS PDSCH receptions.

A UE can be configured by *cfr-ConfigMCCH-MTCH* an MBS frequency resource for PDCCH and PDSCH receptions providing MCCH and broadcast MTCH [12, TS 38.331]; otherwise, the MBS frequency resource is same as for the CORESET with index 0 that is associated with the Type0-PDCCH CSS set for PDCCH and PDSCH receptions providing MCCH and broadcast MTCH. The SCS and CP of MBS frequency resource for broadcast are same as the initial DL BWP. A UE monitors PDCCH for scheduling PDSCH receptions for MCCH or broadcast MTCH as described in clause 10.1.

In clauses referring to a higher layer parameter value provided by *PDCCH-ConfigCommon* or *PDSCH-ConfigMCCH*/*PDSCH-ConfigMTCH*, when applicable a corresponding higher layer parameter value for MCCH/broadcast MTCH PDCCH receptions or PDSCH receptions, respectively, is provided as described in [12, TS 38.331].

A UE can be configured, per DL BWP by *cfr-ConfigMulticast*, an MBS frequency resource within the DL BWP for PDCCH and PDSCH receptions [4, TS 38.211]. If *cfr-ConfigMulticast* does not include *locationAndBandwidthMulticast*, the MBS frequency resource is the DL BWP. The SCS and CP of MBS frequency resource provided by *CFR-ConfigMulticast* are same as the associated DL BWP. In clauses referring to a higher layer parameter value provided by *PDCCH-Config* or *PDSCH-Config* or *SPS-Config* for a DL BWP, when applicable a corresponding higher layer parameter value for multicast PDCCH, PDSCH, or SPS PDSCH receptions is provided as described in [12, TS 38.331].

In clauses referring to a higher layer parameter value provided by a first or second *PUCCH-Config*, when applicable a corresponding higher layer parameter value for PUCCH transmissions associated with multicast PDCCH or PDSCH receptions is provided as described in [12, TS 38.331]. In clauses referring to a higher layer parameter value provided by *n1-PUCCH-AN* or *SPS-PUCCH-AN-List*, when applicable a corresponding higher layer parameter value for PUCCH transmissions associated with multicast SPS PDSCH receptions is provided as described in [12, TS 38.331]. In clauses referring to a higher layer parameter value provided by *pdsch-HARQ-ACK-Codebook* or *pdsch-HARQ-ACK-CodebookList*, when applicable a corresponding higher layer parameter value for HARQ-ACK codebooks associated with multicast HARQ-ACK information is provided as described in [12, TS 38.331].

A UE monitors PDCCH for scheduling PDSCH receptions or for activation/release of SPS PDSCH receptions for a corresponding SPS PDSCH configuration as described in clause 10.1.

A UE can be configured by *harq-FeedbackOptionMulticast,* for a G-RNTI for multicast or for a G-CS-RNTI, to provide HARQ-ACK information for a transport block reception associated with the G-RNTI for multicast or with the G-CS-RNTI, according to the first HARQ-ACK reporting mode if *harq-FeedbackOptionMulticast* is set to'*ack-nack*' or according to the second HARQ-ACK reporting mode if *harq-FeedbackOptionMulticast* is set to'*nack-only* '. The UE determines a priority for a PUCCH transmission with multicast HARQ-ACK information according to any HARQ-ACK reporting mode as described in clause 9 for a PUCCH transmission with unicast HARQ-ACK information.

For the first HARQ-ACK reporting mode, the UE generates HARQ-ACK information with ACK value when a UE correctly decodes a transport block; otherwise, the UE generates HARQ-ACK information with NACK value, as described in clauses 9 and 9.1 through 9.3. The UE determines a PUCCH or a PUSCH to provide the HARQ-ACK information as described in clause 9.2.

For the second HARQ-ACK reporting mode, the UE does not transmit a PUCCH that would include only HARQ-ACK information with ACK values. The second HARQ-ACK reporting mode is not applicable for the first SPS PDSCH reception after activation of SPS PDSCH receptions for a SPS configuration.

For the second HARQ-ACK reporting mode, when a number of HARQ-ACK information bits is one, a UE transmits a PUCCH only when the HARQ-ACK information bit has NACK value. The UE determines a PUCCH to provide the HARQ-ACK information as described in clause 9.2.1 or 9.2.3 when UE is not provided *moreThanOneNackOnlyMode*,or as the first PUCCH in Table 18-1 when UE is provided *moreThanOneNackOnlyMode.* For a PUCCH resource associated with PUCCH format 0, the UE transmits the PUCCH as described in [4, TS 38.211] by obtaining $m\_{0}$ as described for HARQ-ACK information in clause 9.2.3 and by setting $m\_{cs}=0$. For a PUCCH resource associated with PUCCH format 1, the UE transmits the PUCCH as described in [4, TS 38.211] by setting $b\left(0\right)=0$.

A UE that is indicated '*nack-only*' by *harq-FeedbackOptionMulticast*, and for the case when the UE reports more than one HARQ-ACK information bits, the UE can be indicated to provide the HARQ-ACK information bits in a PUCCH either according to the first HARQ-ACK reporting mode when the UE is not provided *moreThanOneNackOnlyMode* or, for only one G-RNTI or only one G-CS-RNTI, according to the second HARQ-ACK reporting mode by selecting a PUCCH resource from a set of PUCCH resources for the PUCCH transmission based on the values of the HARQ-ACK information bits as described in Table 18-1 when the UE is provided *moreThanOneNackOnlyMode*. The UE generates HARQ-ACK information bits for the second HARQ-ACK reporting mode according to a Type-2 HARQ-ACK codebook as described in clause 9.1.3.1. For a PUCCH resource associated with PUCCH format 0, the UE transmits the PUCCH as described in [4, TS 38.211] by obtaining $m\_{0}$ as described for HARQ-ACK information in clause 9.2.3 and by setting $m\_{cs}=0$. For a PUCCH resource associated with PUCCH format 1, the UE transmits the PUCCH as described in [4, TS 38.211] by setting $b\left(0\right)=0$.

For a UE that is indicated the second HARQ-ACK reporting mode, the UE does not expect to be provided *pdsch-HARQ-ACK-Codebook = semi-static* for multicast HARQ-ACK information.

For a UE that is indicated the second HARQ-ACK reporting mode and *moreThanOneNackOnlyMode*, all PUCCH resources associated with the second HARQ-ACK reporting mode have same starting symbol and same number of symbols and, when PUCCH resources in Table 18-1 are located in more than one PRBs, the more than one PRBs are adjacent and are associated with a same MPR value [8-1, TS 38.101-1], [8-5, TS 38.101-5].

Table 18-1: Mapping of values of HARQ-ACK information bits to PUCCH resources for the second HARQ-ACK reporting mode

**<Unchanged parts omitted>**