**3GPP TSG RAN WG1 #113** **R1-230xxxx**

**Incheon, Korea, May 22nd – 26th, 2023**

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| *CR-Form-v12.2* |
| **DRAFT CHANGE REQUEST** |
|  |
|  | **38.213** | **CR** |  | **rev** |  | **Current version:** | **17.5.0** |  |
|  |
| *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 |  | Radio Access Network |  | Core Network |  |

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| ***Title:***  | Introduction of expanded and improved NR positioning |
|  |  |
| ***Source to WG:*** | Samsung |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** | NR\_ pos\_enh2-Core |  | ***Date:*** | 2023-06-04 |
|  |  |  |  |  |
| ***Category:*** | B |  | ***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 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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | Introduction of expanded and improved NR positioning. |
|  |  |
| ***Summary of change:*** |  Introduce support of expanded and improved NR positioning.  |
|  |  |
| ***Consequences if not approved:*** | No support of expanded and improved NR positioning. |
|  |  |
| ***Clauses affected:*** | 3.3, 4.2, 7.3.1, 7.5, 16.2.3A (new) |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  |  |  Other core specifications  | TS 38.331 |
| ***affected:*** |  |  |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

\*\*\* Unchanged parts are omitted \*\*\*

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in [1, TR 21.905].

\*\*\* Unchanged parts are omitted \*\*\*

SFN System frame number

SL Sidelink

SLIV Start and length indicator value

SL PRS Sidelink positioning reference signal

SPS Semi-persistent scheduling

SR Scheduling request

PSCell Primary secondary cell

\*\*\* Unchanged parts are omitted \*\*\*

## 4.2 Transmission timing adjustments

A UE can be provided a value of a timing advance offset for a serving cell by *n-TimingAdvanceOffset* for the serving cell. If the UE is not provided *n-TimingAdvanceOffset* for a serving cell, the UE determines a default value of the timing advance offset for the serving cell as described in [10, TS 38.133].

If a UE is configured with two UL carriers for a serving cell, a same timing advance offset value applies to both carriers.

Upon reception of a timing advance command for a TAG, the UE adjusts uplink timing for PUSCH/SRS/PUCCH transmission on all the serving cells in the TAG based on a value that the UE expects to be same for all the serving cells in the TAG and based on the received timing advance command where the uplink timing for PUSCH/SRS/PUCCH transmissions is the same for all the serving cells in the TAG.

For a band with synchronous contiguous intra-band EN-DC in a band combination with non-applicable maximum transmit timing difference requirements as described in Note 1 of Table 7.5.3-1 of [10, TS 38.133], if the UE indicates *ul-TimingAlignmentEUTRA-NR* as 'required' and uplink transmission timing based on timing adjustment indication for a TAG from MCG and a TAG from SCG are determined to be different by the UE, the UE adjusts the transmission timing for PUSCH/SRS/PUCCH transmission on all serving cells part of the band with the synchronous contiguous intra-band EN-DC based on timing adjustment indication for a TAG from a serving cell in MCG in the band. The UE is not expected to transmit a PUSCH/SRS/PUCCH in one CG when the PUSCH/SRS/PUCCH is overlapping in time, even partially, with random access preamble transmitted in another CG.

For a SCS of kHz, the timing advance command for a TAG indicates the change of the uplink timing relative to the current uplink timing for the TAG in multiples of . The start timing of the random access preamble is described in [4, TS 38.211].

A timing advance command [11, TS 38.321] in case of random access response or in an absolute timing advance command MAC CE, , for a TAG indicates values by index values of = 0, 1, 2, ..., 3846, where an amount of the time alignment for the TAG with SCS of kHz is . is defined in [4, TS 38.211] and is relative to the SCS of the first uplink transmission from the UE after the reception of the random access response or absolute timing advance command MAC CE.

In other cases, a timing advance command [11, TS 38.321], , for a TAG indicates adjustment of a current value, , to the new value, , by index values of = 0, 1, 2,..., 63, where for a SCS of kHz, .

If a UE has multiple active UL BWPs, as described in clause 12, in a same TAG, including UL BWPs in two UL carriers of a serving cell, the timing advance command value is relative to the largest SCS of the multiple active UL BWPs. The applicable value for an UL BWP with lower SCS may be rounded to align with the timing advance granularity for the UL BWP with the lower SCS while satisfying the timing advance accuracy requirements in [10, TS 38.133].

Adjustment of an value by a positive or a negative amount indicates advancing or delaying the uplink transmission timing for the TAG by a corresponding amount, respectively.

For a timing advance command received on uplink slot and for a transmission other than a PUSCH scheduled by a RAR UL grant or a fallbackRAR UL grant as described in clause 8.2A or 8.3, or a PUCCH with HARQ-ACK information in response to a successRAR as described in clause 8.2A, the corresponding adjustment of the uplink transmission timing applies from the beginning of uplink slot where , is a time duration in msec of symbols corresponding to a PDSCH processing time for UE processing capability 1 when additional PDSCH DM-RS is configured, is a time duration in msec of symbols corresponding to a PUSCH preparation time for UE processing capability 1 [6, TS 38.214], is the maximum timing advance value in msec that can be provided by a TA command field of 12 bits, is the number of slots per subframe, is the subframe duration of 1 msec, and , where is provided by *cellSpecificKoffset* and is provided by a Differential Koffset MAC CE command [11, TS 38.321]; otherwise, if not respectively provided,  or . and are determined with respect to the minimum SCS among the SCSs of all configured UL BWPs for all uplink carriers in the TAG and of all configured DL BWPs for the corresponding downlink carriers. For , the UE assumes [6, TS 38.214]. Slot and are determined with respect to the minimum SCS among the SCSs of all configured UL BWPs for all uplink carriers in the TAG. is determined with respect to the minimum SCS among the SCSs of all configured UL BWPs for all uplink carriers in the TAG and for all configured initial UL BWPs provided by *initialUplinkBWP*. The uplink slot is the last slot among uplink slot(s) overlapping with the slot(s) of PDSCH reception assuming , where the PDSCH provides the timing advance command and is defined in [4, TS 38.211].

If a UE changes an active UL BWP between a time of a timing advance command reception and a time of applying a corresponding adjustment for the uplink transmission timing, the UE determines the timing advance command value based on the SCS of the new active UL BWP. If the UE changes an active UL BWP after applying an adjustment for the uplink transmission timing, the UE assumes a same absolute timing advance command value before and after the active UL BWP change.

If the received downlink timing changes and is not compensated or is only partly compensated by the uplink timing adjustment without timing advance command as described in [10, TS 38.133], the UE changes accordingly. If a UE transmits SRS based on a configuration by *SRS-PosResourceSet* in *SRS-PosRRC-InactiveConfig-ValidityArea* in RRC\_INACTIVE state, the UE can autonomously update at cell reselection if the UE is provided *SRS-autonomousTAupdate*; else, the UE maintains the of a last serving cell prior to the release of a dedicated RRC connection.

If two adjacent slots overlap due to a TA command, the latter slot is reduced in duration relative to the former slot. The UE does not change during an actual transmission time window for a PUSCH or a PUCCH transmission [6, TS 38.214].

Using higher-layer ephemeris parameters for a serving satellite, if provided, a UE pre-compensates the two-way transmission delay on the service link based on  that the UE determines using the serving satellite position and its own position. To pre-compensate the two-way transmission delay between the uplink time synchronization reference point and the serving satellite, the UE determines [4, TS 38.211] based on one-way propagation delay that the UE determines as:

where , , and are respectively provided by *ta-Common*, *ta-CommonDrift*, and *ta-CommonDriftVariant* and is the epoch time of , , and [12, TS 38.331]. provides a distance at time between the serving satellite and the uplink time synchronization reference point divided by the speed of light. The uplink time synchronization reference point is the point where DL and UL are frame aligned with an offset given by .

\*\*\* Unchanged parts are omitted \*\*\*

### 7.3.1 UE behaviour

\*\*\* Unchanged parts are omitted \*\*\*

If a UE transmits SRS based on a configuration by *SRS-PosResourceSet* on active UL BWP of carrier of serving cell , the UE determines the SRS transmission power in SRS transmission occasion as

 [dBm]

where,

- and are provided by *p0-r16* and *alpha-r16* respectively, for active UL BWP of carrier of serving cell , and SRS resource set is indicated by *SRS-PosResourceSetId* from *SRS-PosResourceSet*, and

- is a downlink pathloss estimate in dB calculated by the UE, as described in clause 7.1.1 in case of an active DL BWP of a serving cell , using RS resource indexed in a serving or non-serving cell for SRS resource set [6, TS 38.214]. A configuration for RS resource index associated with SRS resource set is provided by *pathlossReferenceRS-Pos*

- if a *ssb-IndexServing* is provided, *referenceSignalPower* is provided by *ss-PBCH-BlockPower*

- if a *ssb-Ncell* is provided, *referenceSignalPower* is provided by *ss-PBCH-BlockPower-r16*

- if a *dl-PRS* is provided, *referenceSignalPower* is provided by *dl-PRS-ResourcePower*

 If the UE is in the RRC\_CONNECTED state and determines that the UE is not able to accurately measure , or the UE is not provided with *pathlossReferenceRS-Pos*, the UE calculates using a RS resource obtained from the SS/PBCH block of the serving cell that the UE uses to obtain *MIB*. If the UE is in the RRC\_INACTIVE state and determines that the UE is not able to accurately measure , the UE does not transmit SRS for the SRS resource set.

 The UE may indicate a capability for a number of pathloss estimates that the UE can simultaneously maintain for all SRS resource sets provided by *SRS-PosResourceSet* in addition to the up to four pathloss estimates that the UE maintains per serving cell for PUSCH/PUCCH transmissions and for SRS transmissions configured by *SRS-Resource*.

If a UE transmits SRS based on a configuration by *SRS-PosResourceSet* outside initial UL BWP of carrier *f* of serving cell *c* in RRC\_INACTIVE state, the active UL BWP *b* refers to the BWP configuration provided by *bwp-NUL* or *bwp-SUL* in *SRS-PosRRC-InactiveConfig* for the corresponding carrier.

If a UE transmits SRS on multiple cells indicated in *SRS-Pos-MultiCell-Config*, the UE calculates on each cell from the multiple cells using *p0-r18* and *alpha-r18* in *SRS-Pos-MultiCell-Config* to determine and , respectively, and using a same value of for each cell from the multiple cells.

If a UE transmits SRS based on a configuration by *SRS-PosResourceSet* in *SRS-PosRRC-InactiveConfig-ValidityArea* in RRC\_INACTIVE state [12, TS 38.331], the active UL BWP *b* refers to the BWP provided by *bwp* in *SRS-PosRRC-InactiveConfig-ValidityArea*. If the UE is not provided *pathlossReferenceRS-Pos* in *SRS-PosResourceSet*, or if the UE is provided *pathlossReferenceRS-Pos* in *SRS-PosResourceSet* and the UE cannot accurately measure a pathloss, the UE calculates using an RS resource from an SS/PBCH block with same index as the one the UE used to obtain *MIB*; otherwise, the UE uses the RS indicated by *pathlossReferenceRS-Pos* to calculate .

\*\*\* Unchanged parts are omitted \*\*\*

## 7.5 Prioritizations for transmission power reductions

For single cell operation with two uplink carriers or for operation with carrier aggregation, if a total UE transmit power for PUSCH or PUCCH or PRACH or SRS transmissions on serving cells in a frequency range in a respective transmission occasion would exceed , where is the linear value of in transmission occasion as defined in [8-1, TS 38.101-1] for FR1 and [8-2, TS 38.101-2] for FR2, the UE allocates power to PUSCH/PUCCH/PRACH/SRS transmissions according to the following priority order (in descending order) so that the total UE transmit power for transmissions on serving cells in the frequency range is smaller than or equal to for that frequency range in every symbol of transmission occasion . If the UE transmits SRS on multiple cells indicated in *SRS-MultiCell-PosConfig*, the UE allocates power so that all REs of the SRS transmissions on the multiple cells have same power.

For the purpose of power allocation in this clause, if a UE is provided *uci-MuxWithDiffPrio* and the UE multiplexes HARQ-ACK information in a PUSCH, a priority index of the PUSCH is the larger of (a) the priority index of the PUSCH according to clause 9 and (b) the larger priority index of the HARQ-ACK information. When determining a total transmit power for serving cells in a frequency range in a symbol of transmission occasion , the UE does not include power for transmissions starting after the symbol of transmission occasion . The total UE transmit power in a symbol of a slot is defined as the sum of the linear values of UE transmit powers for PUSCH, PUCCH, PRACH, and SRS in the symbol of the slot.

- PRACH transmission on the PCell

- PUCCH or PUSCH transmissions with larger priority index

- For PUCCH or PUSCH transmissions with same priority index

- PUCCH transmission with HARQ-ACK information, and/or SR, and/or LRR, or PUSCH transmission with HARQ-ACK information of the priority index

- PUCCH transmission with CSI or PUSCH transmission with CSI

- PUSCH transmission without HARQ-ACK information of the priority index or CSI and, for Type-2 random access procedure, PUSCH transmission on the PCell

- SRS transmission, with aperiodic SRS having higher priority than semi-persistent and/or periodic SRS, or PRACH transmission on a serving cell other than the PCell

In case of same priority order and for operation with carrier aggregation, the UE prioritizes power allocation for transmissions on the primary cell of the MCG or the SCG over transmissions on a secondary cell. In case of same priority order and for operation with two UL carriers, the UE prioritizes power allocation for transmissions on the carrier where the UE is configured to transmit PUCCH. If PUCCH is not configured for any of the two UL carriers, the UE prioritizes power allocation for transmissions on the non-supplementary UL carrier.

\*\*\* Unchanged parts are omitted \*\*\*

### 16.2.3A SL PRS

A UE determines a power for a PL SRS transmission on a resource pool in PL SRS transmission occasion on active SL BWP of carrier as:

where,

* is the maximum output power of the UE [8-1, TS 38.101-1]
* is determined by a value of *sl-MaxTxPower* based on a priority level and a CBR range for a CBR measured in slot , where is the congestion control processing time [6, TS 38.214] ]; if *sl-MaxTxPower* is not provided, then ;
* if a value for is provided
* [dBm]
* else
* [dBm]

where

* if the resource pool is common for PSSCH and SL PRS transmissions, is a value of *dl-P0-PSSCH-PSCCH* or *dl-P0-PSSCH-PSCCH-r17*; else, if the resource pool is dedicated for SL PRS transmissions, is a value of *dl-P0-SLPRS*
* if the resource pool is common for PSSCH and SL PRS transmissions, is a value of *dl-Alpha-PSSCH-PSCCH*, if provided and if *dl-Alpha-PSSCH-PSCCH* is not provided; else, if the resource pool is dedicated for SL PRS transmissions, is provided by *dl-Alpha-SLPRS*
* when the active SL BWP is on a serving cell , as described in clause 7.1.1 except that
* the RS resource is the one the UE uses for determining a power of a PUSCH transmission scheduled by a DCI format 0\_0 in serving cell when the UE is configured to monitor PDCCH for detection of DCI format 0\_0 in serving cell
* the RS resource is the one corresponding to the SS/PBCH block the UE uses to obtain MIB when the UE is not configured to monitor PDCCH for detection of DCI format 0\_0 in serving cell
* is a number of resource blocks for the SL PRS transmission occasion and is a SCS configuration for the SL PRS transmission
* if a value for is provided
* [dBm]
* else
* [dBm]

where

* if the resource pool is common for PSSCH and SL PRS transmissions, is a value of *sl-P0-PSSCH-PSCCH* or *sl-P0-PSSCH-PSCCH-r17*; else, if the resource pool is dedicated for SL PRS transmissions, is a value of *sl-P0-SLPRS*
* if the resource pool is common for PSSCH and SL PRS transmissions, is a value of *sl-Alpha-PSSCH-PSCCH*, if provided and if *sl-Alpha-PSSCH-PSCCH* is not provided; else, if the resource pool is dedicated for SL PRS transmissions, is provided by *sl-Alpha-SLPRS*
* , where
* is obtained
* if the resource pool is common for PSSCH and SL PRS transmissions, from a PSSCH transmit power per RE summed over the antenna ports of the UE and higher layer filtered across PSSCH transmission occasions using a filter configuration provided by *sl-FilterCoefficient*,
* else, if the resource pool is dedicated for SL PRS transmissions, from a TBD transmit power per RE summed over the antenna ports of the UE and higher layer filtered across SL PRS transmission occasions using a filter configuration provided by *sl-FilterCoefficient*
* is a RSRP, as defined in [7, TS 38.215], that is reported to the UE from a UE receiving the SL PRS transmission and is obtained
* if the resource pool is common for PSSCH and SL PRS transmissions, from a PSSCH DM-RS using a filter configuration provided by *sl-FilterCoefficient*
* else, if the resource pool is dedicated for SL PRS transmissions, from a TBD using a filter configuration provided by *sl-FilterCoefficient*
* is a number of resource blocks for the SL PRS transmission occasion and is a SCS configuration for the SL PRS transmission