**3GPP TSG RAN WG1 #114** **R1-230xxxx**

**Toulouse, France, August 21st – 25th, 2023**

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| *CR-Form-v12.2* | | | | | | | | |
| **DRAFT CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.213** | **CR** |  | **rev** |  | **Current version:** | **17.6.0** |  |
|  | | | | | | | | |
| *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 | **x** | Radio Access Network | **x** | Core Network |  |

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| ***Title:*** | Introduction of Network Controlled Repeaters | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Samsung | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_NCR-Core | | | | |  | ***Date:*** | | | 2023-09-01 |
|  |  | | | |  | |  | | |  |
| ***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 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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Introduction of network controlled repeaters (NCR) in NR. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Introduce support for NCR in NR. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | No support for NCR in NR. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 2, 3.3, 10.1, 20 (new clause) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **x** |  | Other core specifications | | | | TS 38.212, TS 38.321, TS 38.331 | | |
| ***affected:*** | |  | **n** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **n** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

# 2 References

[19] 3GPP TS 38.300: "NR; NR and NG-RAN Overall Description"

[20] 3GPP TS 38.106: "NR; NR Repeater Radio Transmission and Reception"

\*\*\* 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 \*\*\*

MBS Multicast broadcast services

MCG Master cell group

MCS Modulation and coding scheme

NCR Network controlled repeater

NCR-Fwd NCR forwarding

NCR-MT NCR mobile termination NDI New Data Indicator

NE-DC E-UTRA NR dual connectivity with MCG using NR and SCG using E-UTRA

NR-DC NR NR dual connectivity

PBCH Physical broadcast channel

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

## 10.1 UE procedure for determining physical downlink control channel assignment

A set of PDCCH candidates for a UE to monitor is defined in terms of PDCCH search space sets. A search space set can be a CSS set or a USS set. A UE monitors PDCCH candidates in one or more of the following search spaces sets

- a Type0-PDCCH CSS set on the primary cell of the MCG configured by

- *pdcch-ConfigSIB1* in MIB or by *searchSpaceSIB1* in *PDCCH-ConfigCommon* or by *searchSpaceZero* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a SI-RNTI, or

- *searchSpaceZero* by providing *searchSpaceID*=0 for *searchSpaceMCCH* or *searchSpaceMTCH* for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI for broadcast

- a Type0A-PDCCH CSS set configured by *searchSpaceOtherSystemInformation* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a SI-RNTI on the primary cell of the MCG

- a Type0B-PDCCH CSS set configured by *searchSpaceMCCH* and *searchSpaceMTCH* for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI for broadcast, on the primary cell of the MCG

- a Type1-PDCCH CSS set configured by *ra-SearchSpace* in *PDCCH-ConfigCommon* for a DCI format with CRC scrambled by a RA-RNTI, a MsgB-RNTI, or a TC-RNTI on the primary cell

- a Type1A-PDCCH CSS set configured by *sdt-SearchSpace* in *PDCCH-ConfigCommon* for a DCI format with CRC scrambled by a C-RNTI or a CS-RNTI on the primary cell as described in clause 19.1

- a Type2-PDCCH CSS set configured by *pagingSearchSpace* in *PDCCH-ConfigCommon* for a DCI format 1\_0 with CRC scrambled by a P-RNTI on the primary cell of the MCG

- a Type2A-PDCCH CSS set configured by *pei-SearchSpace* in *pei-ConfigBWP* for a DCI format 2\_7 with CRC scrambled by a PEI-RNTI on the primary cell of the MCG

- a Type3-PDCCH CSS set configured by

- *SearchSpace* in *PDCCH-Config* with *searchSpaceType* = *common* for DCI formats with CRC scrambled by INT-RNTI, SFI-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI, or CI-RNTI and, only for the primary cell, C-RNTI, MCS-C-RNTI, CS-RNTI(s), or PS-RNTI, or

- *SearchSpace* in *pdcch-ConfigMulticast* for DCI formats with CRC scrambled by G-RNTI, or G-CS-RNTI, or

- *searchSpaceMCCH* and *searchSpaceMTCH* on a secondary cell for a DCI format 4\_0 with CRC scrambled by a MCCH-RNTI or a G-RNTI for broadcast, and

- a USS set configured by

- *SearchSpace* in *PDCCH-Config* with *searchSpaceType* = *ue-Specific* for DCI formats with CRC scrambled by C-RNTI, MCS-C-RNTI, SP-CSI-RNTI, CS-RNTI(s), SL-RNTI, SL-CS-RNTI, SL Semi-Persistent Scheduling V-RNTI, or NCR-RNTI

In the following, DCI formats with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI are also referred to as unicast DCI formats, DCI formats with CRC scrambled by G-RNTI for multicast or G-CS-RNTI are also referred to as multicast DCI formats, and DCI formats with CRC scrambled by MCCH-RNTI or G-RNTI for broadcast scheduling PDSCH receptions are also referred to as broadcast DCI formats.

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

For each DL BWP configured to a UE in a serving cell, the UE is provided by higher layers with search space sets where, for each search space set from the search space sets, the UE is provided the following by *SearchSpace*:

- a search space set index , , by *searchSpaceId*

- an association between the search space set and a CORESET by *controlResourceSetId* or by *controlResourceSetId-v1610*

- a PDCCH monitoring periodicity of slots and a PDCCH monitoring offset of slots, by *monitoringSlotPeriodicityAndOffset* or by *monitoringSlotPeriodicityAndOffset-r17*

- a PDCCH monitoring pattern within a slot, indicating first symbol(s) of the CORESET for PDCCH monitoring within each slot where the UE monitors PDCCH, by *monitoringSymbolsWithinSlot*

- a duration of indicating a number of slots that the search space set exists by *duration*, or a number of slots in consecutive groups of slots where the search space set can exist by *duration-r17*

- a bitmap, by *monitoringSlotsWithinSlotGroup*, that applies per group of slots and provides a PDCCH monitoring pattern indicating slots in a group of slots for PDCCH monitoring

- a size of the group of slots is same as a size of *monitoringSlotsWithinSlotGroup*

- for a Type1-PDCCH CSS set provided by *ra-SearchSpace* in dedicated RRC signaling, or for a Type3-PDCCH CSS set, or for a USS set, the PDCCH monitoring pattern indicates only consecutive slots in the group of slots for PDCCH monitoring and, at least for one combination indicated by the UE as a capability, a number of the consecutive slots is not larger than

- for a Type1-PDCCH CSS set provided by *ra-SearchSpace* in *SIB1*, the PDCCH monitoring pattern indicates only up to 1 slot in the group of slots for PDCCH monitoring

- for a Type0-PDCCH CSS set or for a Type0A-PDCCH CSS set, or for a Type2-PDCCH CSS set, the PDCCH monitoring pattern indicates slots in the group of slots for PDCCH monitoring, and the slots are not restricted to be consecutive, and the number of those slots is not larger than the size of *monitoringSlotsWithinSlotGroup*

- a number of PDCCH candidates per CCE aggregation level by *aggregationLevel1*, *aggregationLevel2*, *aggregationLevel4*, *aggregationLevel8*, and *aggregationLevel16*, for CCE aggregation level 1, CCE aggregation level 2, CCE aggregation level 4, CCE aggregation level 8, and CCE aggregation level 16, respectively

- an indication that search space set is either a CSS set or a USS set by *searchSpaceType*

- if search space set is a CSS set

- an indication by *dci-Format0-0-AndFormat1-0* to monitor PDCCH candidates for DCI format 0\_0 and DCI format 1\_0

- an indication by *dci-Format2-0* to monitor one or two PDCCH candidates, or to monitor one PDCCH candidate per RB set if the UE is provided *freqMonitorLocations* for the search space set, for DCI format 2\_0 and a corresponding CCE aggregation level

- an indication by *dci-Format2-1* to monitor PDCCH candidates for DCI format 2\_1

- an indication by *dci-Format2-2* to monitor PDCCH candidates for DCI format 2\_2

- an indication by *dci-Format2-3* to monitor PDCCH candidates for DCI format 2\_3

- an indication by *dci-Format2-4* to monitor PDCCH candidates for DCI format 2\_4

- an indication by *dci-Format2-6* to monitor PDCCH candidates for DCI format 2\_6

- an indication by *dci-Format4-0* to monitor PDCCH candidates for DCI format 4\_0

- an indication by *dci-Format4-1*, or *dci-Format4-2*, or *dci-Format4-1-AndFormat4-2* to monitor PDCCH candidates for DCI format 4\_1, or DCI format 4\_2, or for both DCI format 4\_1 and DCI format 4\_2, respectively

- an indication by *searchSpaceLinkingId* that search space set is linked to another search space set for which is provided a same value for *searchSpaceLinkingId*

- if search space set is a USS set, an indication by *dci-Formats* to monitor PDCCH candidates either for DCI format 0\_0 and DCI format 1\_0, or for DCI format 0\_1 and DCI format 1\_1, or an indication by *dci-FormatsExt* to monitor PDCCH candidates for DCI format 0\_2 and DCI format 1\_2, or for DCI format 0\_1, DCI format 1\_1, DCI format 0\_2, and DCI format 1\_2, or an indication by *dci-FormatsSL* to monitor PDCCH candidates for DCI format 0\_0 and DCI format 1\_0, or for DCI format 0\_1 and DCI format 1\_1, or for DCI format 3\_0, or for DCI format 3\_1, or for DCI format 3\_0 and DCI format 3\_1, on an indication by *dci-Format-NCR* to monitor PDCCH candidates for DCI format 2\_8

- a bitmap by *freqMonitorLocations*, if provided, to indicate an index of one or more RB sets for the search space set , where the MSB in the bitmap corresponds to RB set in the DL BWP. For RB set indicated in the bitmap, the first PRB of the frequency domain monitoring location confined within the RB set is given by , where is the index of first common RB of the RB set [6, TS 38.214], and is provided by *rb-Offset* or if *rb-Offset* is not provided. For each RB set with a corresponding value of 1 in the bitmap, the frequency domain resource allocation pattern for the monitoring location is determined based on the first bits in *frequencyDomainResources* provided by the associated CORESET configuration.

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

# 20 Network controlled repeater

An NCR includes an NCR-MT entity and an NCR-Fwd entity [19, TS 38.300].

Throughout this specification, unless otherwise noted, statements using the term "UE" in Clauses 4 through 13 are equally applicable to the NCR-MT.

A procedure for the NCR-MT to perform cell search, system information acquisition, random access procedure, UCI reporting, or PDCCH monitoring is same as a corresponding one for a UE. A procedure for the NCR-MT to perform PDSCH reception, CSI-RS measurements and CSI determination, PUSCH transmission, or SRS transmission is same as a corresponding one for a UE as described in [6, TS 38.214].

The NCR-Fwd transmits or receives only after the NCR-MT receives on the control link an indication for one or more beams [20, TS 38.106] for the NCR-Fwd to use for transmissions or receptions over corresponding one or more time resources on the access link.

When the NCR-MT performs a link recovery procedure as described in Clause 6, the NCR-Fwd does not transmit or receive until the link recovery procedure is complete [11 TS 38.321].

The NCR can be provided, through the NCR-MT, *tdd-UL-DL-ConfigurationCommon* and, additionally, *tdd-UL-DL-ConfigurationDedicated*. The NCR-Fwd receives on the backhaul link or transmits on the access link only in symbols indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated*. The NCR-Fwd receives on the access link or transmits on the backhaul link only in symbols indicated as uplink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated*.

When the NCR simultaneously receives via both the control link and the backhaul link in a set of symbols, a TCI state for receptions on the backhaul link is same as a TCI state for receptions on the control link in the set of symbols. When the NCR simultaneously transmits via both the control link and the backhaul link in a set of symbols, a spatial filter for transmissions on the backhaul link is same as a spatial filter for transmissions on the control link in the set of symbols.

When the NCR does not simultaneously receive on the control link and the backhaul link

- if the NCR does not support determination of a TCI state for receptions on the backhaul link based on an indication of a TCI state by the serving cell, or if the NCR does not receive an indication of a TCI state, for receptions on the backhaul link [11, TS 38.321]

- if the NCR does not receive an indication of a unified TCI state for receptions by the NCR-MT, receptions on the backhaul link use same QCL parameters as the ones for PDCCH receptions in a CORESET with the lowest *controlResourceSetId*

- else, receptions on the backhaul link use the QCL parameters provided by an indicated unified TCI state for receptions by the NCR-MT

- else receptions on the backhaul link use QCL parameters provided by a TCI state in a MAC CE [11, TS 38.321].

When the NCR does not simultaneously transmit on the control link and the backhaul link

- if the NCR does not support determination of a spatial filter for transmissions on the backhaul link based on an indication of a unified TCI state or SRI by the serving cell, or if the NCR-MT does not receive an indication of a unified TCI state or SRI for determining a spatial filter, for transmissions on the backhaul link

- if the NCR does not receive an indication of a unified TCI state for transmissions by the NCR-MT, transmissions on the backhaul link use a same spatial filter as the one associated with the PUCCH resource with the smallest *pucch-ResourceId* in *PUCCH-ResourceSet*

- else, transmissions on the backhaul link use a spatial filter corresponding to an indicated unified TCI state for transmissions by the NCR-MT.

- else transmissions on the backhaul link use a spatial filter corresponding to a unified TCI state or SRI provided by a MAC CE [11, TS 38.321].

The NCR-Fwd uses a same beam for transmissions and receptions on the access link during respective time resources associated with the beam.

The NCR can be provided by *ncr-PeriodicFwdResourceSetToAddModList* a list of sets of resources for transmissions or receptions on the access link. A set of resources, from the list of sets of resources, is provided by *NCR-PeriodicFwdResourceSet* and occurs with a periodicity provided by *ncr-periodicity*. A resource from the set of resources is provided by *NCR-PeriodicFwdResource* and includes a pair of a time resource provided by *ncr-PeriodicTimeResource* and a beam [20, TS 38.106] with an index provided by *ncr-beamIndex*. The time resource starts at a slot that is offset by *slotOffsetPeriodic* slots from the start of the period for the set of resources and at a symbol that is offset by *symbolOffset* from the start of the slot, and has a duration provided by *durationInSymbols* for a SCS provided by *ncr-referenceSCS*.

The NCR can be provided by *ncr-SemiPersistentFwdResourceSetToAddModList* a list of sets of resources for transmissions or receptions on the access link and a MAC CE command can indicate a set of resources for the NCR to use or to stop using based on a corresponding identity provided by *ncr-SemiPersistentFwdResourceSetId* [11, TS 38.321]. The NCR uses or stops using the set of resources starting from the first slot that is after slot where is the slot where the NCR-MT would transmit a PUCCH with HARQ-ACK information associated with the PDSCH providing the MAC CE command and is the SCS configuration for the PUCCH transmission. The set of resources is provided by *NCR-SemiPersistentFwdResourceSet* and occurs with a periodicity provided by *ncr-periodicity*. A resource from the set of resources is provided by *NCR-SemiPersistentFwdResource* and includes a pair of a time resource provided by *ncr-SemiPersistentTimeResource* and a beam with an index provided by *ncr-beamIndex*, where *beamIndex* can be updated by the MAC CE command. The time resource starts at a slot that is offset by *slotOffsetSemiPersistent* slots from the start of the period for the set of resources and at a symbol that is offset by *symbolOffset* from the start of the slot, and has a duration provided by *durationInSymbols* for a SCS provided by *ncr-referenceSCS*.

The NCR-MT can be configured to monitor PDCCH according to USS sets for detection of a DCI format 2\_8 with CRC scrambled by an NCR-RNTI. A time resource and a corresponding beam index for transmissions or receptions on the access link are indicated by corresponding fields in DCI format 2\_8 [4, TS 38.212]. When the NCR detects more than one DCI formats 2\_8 that indicate beam indexes for time resources overlapping in a set of symbols, the NCR uses for the set of symbols a beam index that is indicated by a DCI format 2\_8 that the NCR-MT detects in a most recent PDCCH monitoring occasion. The time resource starts at a slot that is offset by *slotOffsetAperiodic* slots from a reference slot and at a symbol that is offset by *symbolOffset* from the start of the slot, and has a duration provided by *durationInSymbols* for a SCS provided by *ncr-referenceSCS*. The reference slot is a slot that is after a slot of a PDCCH reception that provides the DCI format 2\_8 by a number of slots indicated by FG 43-3.

If

- a first time resource provided by *NCR-SemiPersistentFwdResourceSet* is indicated by a MAC CE command and is associated with a first beam index, and

- a second time resource is provided by *NCR-PeriodicFwdResourceSet* and is associated with a second beam index, and

- the first time resource overlaps with the second time resource in a set of symbols,

the NCR applies the first beam index for transmissions or receptions on the access link in the set of symbols.

If

- a first time resource is provided by *NCR-PeriodicFwdResourceSet* or *NCR-SemiPersistentFwdResourceSet* and is associated with a first beam index, and

- a second time resource is indicated by DCI format 2\_8 and is associated with a second beam index provided by the DCI format 2\_8, and

- the first time resource overlaps with the second time resource in a set of symbols,

the NCR applies, for transmissions or receptions on the access link in the set of symbols,

- the first beam index if *NCR-PeriodicFwdResourceSet* or *NCR-SemiPersistentFwdResourceSet* includes *priorityFlag*, and

- the second beam index if *NCR-PeriodicFwdResourceSet* or *NCR-SemiPersistentFwdResourceSet* does not include *priorityFlag*.

The NCR does not expect overlapping time resources provided by either *NCR-PeriodicFwdResourceSet* or *NCR-SemiPersistentFwdResourceSet* to be associated with different beam indexes.