3GPP TSG RAN WG1 #112bis-e R1-23xxxxx

**E-meeting, April 17th – 26th, 2023**

Source: Moderator (ZTE)

Title: Summary of MAC CE parameters for NCR

Agenda Item: 9.18

**Document for: Discussion and Decision**

# Introduction

In this summary, the remaining issues on MAC CE parameters are discussed based on the progress achieved in RAN1#112.

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| **Agreement**  The RRC parameters and MAC CE parameters in R1-2302113 are agreed. LS to RAN2 is agreed in R1-2302227. |

# MAC CE parameters

## **Company view (Round-1)**

### **Activation/deactivation field**

For the backhaul link beam information, following agreement was achieved in RAN1#111:

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| **Agreement**  The semi-static beam indication for backhaul link is supported as:   * If the beam indication framework in Rel-15 is used for NCR-MT * The DL beam is indicated by MAC CE to select one of TCI state ID from the RRC-configured list of beams for C-link   + The UL beam is indicated by SRI on C-link via MAC CE. * If the beam indication framework in Rel-17 is used for NCR-MT   + The DL and UL beam are indicated by MAC CE to select one of TCI state ID from the RRC-configured list of beams for C-link |

[ZTE] proposes to include A/D field in backhaul link beam indication because without A/D field, if gNB decides to indicate one MAC CE for backhaul link at one time, gNB can no longer decides to deactivate it and let backhaul link beam follow C-link beam according to the pre-defined rule, instead, gNB has to always indicate the MAC CE from one TCI state to another. It’s not reasonable to restrict gNB to always indicate the backhaul link beam, it can be up to gNB to deactivate the TCI state and let backhaul link beam follow C-link if applicable.

[vivo] suggests to not include A/D field in backhaul link beam indication because when gNB deactivates the backhaul link beam indication, it’s not clear which beam will be used for NCR, to avoid spec impact, A/D field should be excluded.

From Moderator’s perspective, it has been agreed that when there is no indicated beam, pre-defined rule will be used, i.e., when gNB de-activates the indicated beam for backhaul link, the pre-defined rule will be used. Meanwhile, keeping this filed is also aligned with the functionality of MAC CE and no additional spec effort is needed to keep the A/D field. So, the following is proposed:

***Proposal 1-1-1:*** *The following field is added to the MAC CE for backhaul link*

*- A/D: This field indicates whether to activate or deactivate indicated TCI state. The field is set to 1 to indicate activation, otherwise it indicates deactivation.*

Companies are encouraged to share your view.

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| Companies | Comments and Views |
| NTT Docomo | Do not support. We don’t see the need to have the A/D field. |
| Fujitsu | We do not support the proposal. In our view, there is no strong motivation to include A/D field in the MAC CE. Typically, it is not needed to frequently switch between the indicated BH-link beam and the beam determined by the predefined rule. Even if the MAC CE does not include A/D field, gNB can reset the NCR to use the pre-defined rule, e.g. by RRC reconfiguration etc. In addition, introducing A/D field may require additional spec. effort. For example, the application time of deactivation needs to be discussed. |
| Samsung | We do not agree to introduce A/D field in the MAC-CE for backhaul link. For backhaul link beam indication, it is more efficient to use the next MAC-CE to override the previous one instead of deactivation command using A/D indicator.  The BH MAC-CEs simply indicate which BH beam to use (the actual slots/symbols to operate the BH beam is agreed to be based on the signaling/operation by the Access link). The deactivation of backhaul link beam will cause a beam selection “hole” as the NCR would need to switch back and forth between the MAC-CE beam and the default/predetermined beam which is not necessary. Whenever an update for BH beam is needed, the gNB will send a new MAC-CE for BH beam indication. |
| Huawei, HiSilicon | Don’t support. Similar to others, we don’t see the need to activate/deactivate the beam indication for backhaul link from the gNB. |
| Vivo | NCR works w/o supporting this A/D, so this field is not preferred by us. We see the motivation of this field is to enable switching between explicit BH beam indication and the implicit rule, if the majority want this functionality, we can consider it. |
| Apple | Don’t support |
| Nokia | Don’t support. We share the view with other companies that this is not necessary. Since a MAC CE is need anyway to de-activate the current backhaul beam, an update can just as easily be provided. |
| Ericsson | We **do not support** the proposal. The deployment of NCR is stationary, and it can be assumed that channel conditions are therefore stationary and robust. There is no need for rapid adjustment of beams, be it the c-link or backhaul link beam, irrespective how the backhaul beam is determined. |
| Intel | We share similar view with other companies that there is no need of frequent update of backhaul beams, so no need of activation/deactivation bit field. |
| LG | Do not support. We do not have separate agreement regarding activation/deactivation of MAC-CE. |
| Moderator | Given the concerns from companies, it seems reasonable to not support the A/D field in the MAC CE. Then, following updated proposal is provided:  ***Updated Proposal 1-1-1:*** *No A/D field is included in MAC CE for backhaul link beam indication.* |

### **The BWP where TCI-States is configured**

As agreed before, the TCI state of backhaul link is selected from the RRC configured TCI state list for C-link, but the BWP where TCI state list is configured for C-link has not been determined yet.

According to companies’ contributions, the following options are proposed:

* Option-1: The TCI state of backhaul link is selected from the TCI state list in active BWP of C-link

1. [ZTE] proposes that for the data transmission, the C-link between Gnb and NCR-MT will operate at active BWP to carry the SCI, e.g., via PDSCH/PDCCH. In this case, as the example shown below for the legacy UE the active BWP of C-link is used as reference BWP to indicate the TCI state of backhaul link. Although, the active BWP may be switched for C-link transmission, it’s always applicable to rely on the TCI state list of current active BWP for C-link.

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| 6.1.3.15 TCI State Indication for UE-specific PDCCH MAC CE - TCI State ID: This field indicates the TCI state identified by *TCI-StateId* as specified in TS 38.331 [5] applicable to the Control Resource Set identified by CORESET ID field. If the field of CORESET ID is set to 0, this field indicates a *TCI-StateId* for a TCI state of the first 64 TCI-states configured by *tci-StatesToAddModList* and *tci-StatesToReleaseList* in the *PDSCH-Config* in the active BWP. If the field of CORESET ID is set to the other value than 0, this field indicates a *TCI-StateId* configured by *tci-StatesPDCCH-ToAddList* and *tci-StatesPDCCH-ToReleaseList* in the *controlResourceSet* identified by the indicated CORESET ID. The length of the field is 7 bits. |

* Option-2: The TCI state of backhaul link is selected from the TCI state list in default BWP of C-link

1. [LGE] proposes that the Gnb and NCR should always have a common understanding of the BWP ID for indication of the TCI state ID, and it would be appropriate to use the default BWP as a reference. This should apply to both the Rel-15/16 TCI state ID, where the DL beam is indicated, and the Rel-17 unified TCI state ID, where both DL and UL beams are indicated.

* Option-3: BWP ID field is added in MAC CE

1. [vivo] suggests that BWP ID bitfield can be included in the backhaul beam indication signalling considering that UE connected via NCR can be on a different BWP from the control link BWP.
2. From Moderator’s perspective, the MAC CE carrying backhaul link beam indication is transmitted in the active BWP of C-link, which implies there will be an active BWP for C-link, it’s natural for backhaul link to use the TCI state selected from the RRC configured list in active BWP. The default BWP may not be appropriate since the TCI state pool might be outdated, and a new BWP ID field is not desirable. Then, the following is proposed:

***Proposal 1-1-2:*** *The TCI state of backhaul link is selected from the TCI state list in active BWP of C-link.*

Companies are encouraged to share your view.

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| Companies | Comments and Views |
| NTT Docomo | Support the proposal. |
| Fujitsu | We are OK with the direction of the proposal. But some issues need to be resolved.  1.The proposal is only applicable for DL or joint TCI state. A similar proposal or bullet dedicated to UL is needed.  2. It is necessary to clarify how to handle the case of BWP switching.  So, we suggest the following update.  ***Proposal 1-1-2:***  *Regarding to backhaul link beam indication for backhaul link via MAC CE,*   * *The TCI state of backhaul link is selected from the TCI state list in active DL BWP of C-link.*   + *In case of DL BWP switching of C-link,* *the TCI state of backhaul link is determined based on the TCI state list of the new active DL BWP, i.e., the TCI state ID indicated by the MAC CE refers to the TCI state with the same ID in the TCI state list of the new active DL BWP.* * *The UL TCI state or SRI of backhaul link is selected from the UL TCI state list or SRI list in active UL BWP of C-link.*   + *In case of UL BWP switching of C-link, the UL TCI state or the SRI of backhaul link is determined based on the UL TCI state list or the SRI list of the new active UL BWP, i.e., the UL TCI state ID or SRI ID indicated by the MAC CE refers to the UL TCI state with the same ID in the UL TCI state list or the SRI with the same ID in the SRI list of the new active DL BWP.* |
| Samsung | Do not support the proposal.  In our view, a solution of introducing a BWP ID field is preferred. This solution works for both Rel-15 beam indication framework and Rel-17 beam indication framework.  In comparison, the solution of using the TCI state list in active BWP works for Rel-15 beam indication framework but not for Rel-17 beam indication framework. If Rel-17 beam indication framework is used, TCI state list is usually configured within only in one of the configured BWPs. Other BWPs can use *ServingCellAndBWP-Id-r17* for the referencing of the TCI state list. It is possible that there is no TCI list configured in the active BWP.  By introducing a field for BWP ID can also resolve the issue mentioned by Fujitsu. As agreed by RAN2, two MAC-CE will be specified for backhaul link. For example, a DL BH link MAC-CE and an UL BH link MAC-CE. The DL BH link MAC-CE can be added with DL BWP ID field for indicating the NCR-MT BWP that the TCI state list is referencing from. Meanwhile, The UL BH link MAC-CE can be added with UL BWP ID field for indicating the NCR-MT BWP that the TCI state list or SRI is referencing from.  Apart from the ambiguity of BWP, there is a similar issue that which Serving Cell that the TCI state list belongs to. In our view, considering that there is no support of CA functionality of NCR-MT, the Serving Cell for the TCI state should be the Pcell of NCR-MT. |
| Huawei, HiSilicon | Support |
| vivo | BWP ID bitfield can be included in the backhaul beam indication signalling considering that UE connected via NCR can be on a different BWP from the control link BWP |
| Apple | Support |
| Nokia | Support the proposal. |
| Ericsson | We **do not support** the proposal. Changing active BWP of the MT would require that the backhaul link beam is reconfigured, even there is no need; especially not since a certain BWP configuration has generally not much effect on the requirements and conditions of the backhaul link.  We **support option 3**, explicitly indicating the BWP ID, since it covers option 1 and option 2 with negligeable overhead in very infrequent signaling. |
| Intel | Support the proposal.  In our understanding, BWP switch is not typical for NCR-MT. |
| LG | Although our preference is option 2, we can compromise to option 3 considering it includes option 1 and option 2, as commented by Ericsson. |
| Moderator | After reviewing the inputs, it seems that the controversial scenario is how to handle the case when the BWP switching for the C-link occurs.  In my view, based on the previous agreement, the TCI state for backhaul link should be always belonging to the same set of TCI for C-link.  With such restriction, it will minimize the load for beam maintenance and in in-band mode of NCR, the measured results from NCR-MT can be directly reused to determine the best beam of backhaul link. Otherwise, if beams with different BWP ID is considered for backhaul link, to optimize the backhaul link, additional overhead is required to select the beam.  For Fujitsu’s comment, we can update the proposal by adding the UL part. For the BWP switching part, since we already highlight that it will follow the active BWP, the additional details in the second level bullets are also covered.  Then, the following updated proposal is provided:  ***Updated Proposal 1-1-2:*** *For the backhaul link beam indication:*   * *The TCI state for the DL beam indication of backhaul link is selected from the TCI state list in active DL BWP of C-link.* * *The TCI state or SRI for the UL beam indication of backhaul link is selected from the UL TCI state list or SRI list in active UL BWP of C-link.* |

# Others

In addition, some other aspects are summarized below only for information since they are not relevant to the MAC CE parameters:

* Issue-1: Simultaneous backhaul and C-link

When simultaneous backhaul link and C-link transmission happens, [LGE, Huawei, Intel] discuss the issue with following views

* [Huawei] proposes that priority rule can be defined depending on the signals of C-link and the beam indication type of backhaul link, furthermore, the output power of each link can be calculated according to the priority.
* [LGE] thinks that to determine the backhaul link beam, C-link is considered to operate at the time resource of RO and SSB transmission. In addition, semi-static beam indication for backhaul link is valid until backhaul link beam is changed due to pre-defined rule.
* [Intel] suggests that for a UE supporting simultaneous UL transmission of C-link and backhaul link, C-link is prioritized for UL power allocation in a symbol with UL transmission in both C-link and backhaul link. For a UE not supporting simultaneous UL transmission of C-link and backhaul link, backhaul link is dropped in a symbol with UL transmission in C-link.

From FL’s perspective, this issue does not have impact on higher layer signalling and can be discussed in maintenance phase if needed.

* Issue-2: bitwidth of beam index

In this meeting, [Ericsson] proposes that RAN1 confirms that the RRC configured bit width of the beam indication field in the dynamic beam indication DCI format 5\_0 is determined by the number of beams used for the access link as provided by OAM. Hence, the number of bits of a beam indication field is ceil(log2(NA-beams)).

From FL’s perspective, it’s correct that the RRC configured bit width of beam index field is determined by actual beams of NCR, and such information is delivered to Gnb via OAM, but considering that OAM is implementation based, this does not have spec impact.

* Issue-3: Backhaul link beam switching

[vivo] proposes that the backhaul beam switching timing is the slot boundary derived from the reference SCS which is defined in DL/UL slot format configuration.

From FL’s perspective, this issue does not have impact on higher layer signalling and can be discussed in maintenance phase if needed.

* Issue-4 Priority flag

[vivo] proposes that if priority flag is given to both periodic indication and semi-persistent indication, semi-persistent indication has higher priority than periodic indication.

[Huawei] thinks that for conflicted forwarding resources of different indications, the indicated time in a slot by a lower priority indication is valid if there is no overlapping in the slot, otherwise it is invalid.

From FL’s perspective, this issue does not have impact on higher layer signalling and can be discussed in maintenance phase if needed.

* Issue-5 Explicit OFF

[LGE] proposes that explicit OFF indication should be supported via beam indication by reserving a beam index or codepoint of beam indication field as OFF indication.

From FL’s perspective, this issue has been discussed for multiple meetings and companies cannot reach consensus, it can be de-prioritized.

* Issue-6 the reference of slot offset k

[Huawei] proposes that the reference of slot offset k for NCR aperiodic indications can be defined by NCR-MT capability, e.g., 14/28 OFDM symbols.

[Intel] supports NCR-MT capability report for beam application latency k by adding new value for existing parameter timeDurationForQCL to incorporate additional delay caused by inter-module delay Y or adding a new parameter Y in addition to existing parameter timeDurationForQCL.

From FL’s perspective, this issue is more related to UE capability discussion, it can be discussed in AI 9.17.4.

* Issue-7 Repeated DCI

[Huawei] proposes that for each aperiodic beam indication by DCI, the indication is repeated within a PDCCH monitoring periodicity.

From FL’s perspective, if periodic forwarding is required, periodic and semi-persistent beam indication can be used, no need to use DCI to indicate the beam to forward periodic signals.

* Issue-8 DCI format 5\_0

[Intel] proposes that CSS is not supported for DCI format 5\_0. In addition, UE specific search space for DCI format 5\_0 is separately configured from the UE specific search space for legacy DCI format. Existing DCI size budget (M=4, N=3) is reused for NCR-MT. The DCI size of DCI format 5\_0 with dedicated RNTI is counted in M not in N.

From FL’s perspective, legacy USS configuration is flexible enough, no need to define a separate USS configuration dedicated for NCR. As for the DCI size budget, it’s correct that DCI format 5\_0 is counted in M since NCR uses dedicated RNTI, no spec impact is needed.

Companies are encouraged to share your views if any

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| Companies | Comments and Views |
| Samsung | We are open to discuss issue 1. |
| Ericsson | **Issue-2:** We disagree with the FL conclusion on Issue-2. Since it is an RRC parameter, surely there is specification impact! Additionally, it is not clear what the NCR should assume if the #bits for beam index indication is smaller than ceil(log2(NA-beams)). A value larger than ceil(log2(NA-beams)) obviously results in unnecessary signaling overhead, which can hardly be the intention. If the value depends on OAM and thus implementation, as suggested by the moderator, the RRC information is of little/no use for the communication between Gnb and NCR. In this case, there would be no specification impact. It is our understanding that this parameter is superfluous and may cause ambiguity.  **Other open issues not mentioned by the FL**  **Payload size of DCI:** Currently, the payload size of the DCI 5\_0 (aka 2\_8) is not specified. We propose to have the payload indicated by a higher layer parameter to NCR-MT. The maximum payload size is [128] bits.  **Actual number of beam indication in DCI 5\_0:** So far, there is no agreement that every DCI 5\_0 has to indicate the maximum number of time/beam indications. The actual number of indicated beams in one dynamic beam indication DCI format 5\_0 should be dynamic, according to scheduling decisions and scheduling horizons. So far, there is no mechanisms to indicate the actual number of beam/time pairs provided in a respective DCI 5\_0. We propose that **the actual number of indicated beams in one dynamic beam indication DCI format 5\_0 is explicitly indicated in the same DCI**. |
| Intel | Just to clarify our intension of separate configuration of Search space for DCI 5\_0 and legacy DCI in issue-8. In existing system, one search space is configured with one DCI format, while some DCI formats can be configured together as shown below. Similar to DCI format 2-5 for IAB-MT, DCI format 5\_0 for NCR can be separately configured. |
| LG | The precise definition of simultaneous operation for NCR-MT and NCR-Fwd on backhaul link is required since the what we have agreed upon are based on it, i.e., whether NCR applies indicated beam or follows pre-defined rule for backhaul link beam determination.  Regarding on actual number of beam indication in DCI 5\_0, we share similar view with Ericsson. How many forwarding resources are indicated via single DCI can be discussed further.  And for issue 5, it should be noted that NCR cannot be indicated to be OFF currently and only default to be OFF, which means once beam is indicated to NCR on certain time resource, then NCR should somehow remained to be ON on that resource.  We are aware of that some of companies think explicit OFF indication can be supported without specification, by access link beam indication using NULL beam since the information of physical beam for access link is delivered via OAM. However, even the beam index can be mapped to NULL beam, if it is not specified as OFF operation, then NCR is not expected to achieve power requirement of OFF state, which cannot guarantee the original purpose of ON-OFF indication, i.e., interference reduction and power saving. |

# Proposals for discussion at GTW sessions

# Conclusion

# Appendix

R1-2302518 Discussion on Rel-18 Multi-carrier enhancements, eDSS, NCR and BWP without restriction vivo

R1-2302820 On remaining issues for R18 NCR and MC-Enh Intel Corporation

R1-2303163 Introduction of network controlled repeaters Samsung

R1-2303164 Correction for BWP operation without restriction Samsung

R1-2303166 Discussion on remaining issues for eDSS and MC Spreadtrum Communications

R1-2303292 Discussion on the higher layer parameters for NCR Rapporteur(ZTE)

R1-2303431 Remaining aspects on Rel-18 NCR and Multi-carrier enhancements LG Electronics

R1-2303766 Discussion on MCE, eDSS and NCR for Rel18 Ericsson

R1-2303804 Introduction of Rel-18 network controlled repeaters Huawei, HiSilicon

R1-2303858 Remaining issues for eDSS, NCR, multicarrier enhancements Huawei, HiSilicon