3GPP TSG-RAN WG2 #113 electronic R2-20xxxxx

Electronic Meeting, Jan 25 – Feb 05, 2021

Agenda Item: x.x.x.x

Source: Ericsson

Title: Summary of e-mail discussion on UE indication when it no longer experiences overheating

Document for: Discussion, Decision

# 1 Introduction

This contribution summarizes the following e-mail discussion:

* [Post112-e][067][NR TEI16] UE indication when it no longer experiences overheating (Ericsson)

      Scope: Based on R2-2010543, find solution, prepare for decisions next meeting

      Intended outcome: Report

      Deadline: Long

# 2 Discussion

The general overheating framework is that the UE indicates that it no longer experiences overheating by including an overheating assistance IE without any fields inside. This behaviour is handled explicitly e.g. as in NR SA:

(From TS 38.331)

2> else (if the UE no longer experiences an overheating condition):

3> do not include reducedMaxCCs, reducedMaxBW-FR1, reducedMaxBW-FR2, reducedMaxMIMO-LayersFR1 and reducedMaxMIMO-LayersFR2 in OverheatingAssistance IE;

However, it is not clear whether a similar principle is applicable to the SCG in EN-DC case, i.e. whether the SN should always be informed that there is no longer a preference for the SCG configuration concerning overheating. This was discussed in RAN2#112-e and no conclusion was reached:

R2-2010543 UE indication when it no longer experiences overheating Ericsson discussion NR\_newRAT-Core

- [029] Rapporteur: Continue to discuss R2-2010543 in phase 2, including:

 - Whether UE needs to inform network overheating of SCG is resolved? And whether absence of *overheatingAssistanceForSCG* field is sufficient for this purpose?

 - Continue to discuss Proposal 2 to ensure all companies have the same understanding on inter-node operation.

* [029] Noted
* [029] Discuss by email to next meeting
* [AT112-e][067][NR TEI16] UE indication when it no longer experiences overheating (Ericsson)

 Scope: Based on R2-2010543, find solution, prepare for decisions next meeting

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Furthermore, given the discussion in RAN2#112-e, it could be good to confirm also for NR-DC case whether companies have the same understanding on the SN aspects mentioned to EN-DC. Therefore, NR-DC is also discussed in this document.

## 2.1 EN-DC

In Rel-16, the UE in EN-DC may send an overheating indication concerning the SCG by including *overheatingAssistanceForSCG* within the *OverheatingAssistance* IE. If the UE would indicate that it no longer has a preference for the SCG concerning overheating, it could indicate it by including *overheatingAssistanceForSCG* without any fields therein, as done for the overall overheating framework (see the excerpt above). It should also be noted that the overall handling of 36.331 and 38.331 procedures may also result in an empty overheating assistance IE (see Annex A).

1. The current UE behaviour for EN-DC in Rel-16 can already result in the report of overheating including *overheatingAssistanceForSCG* without any fields therein.

Nevertheless, this behaviour is not consistently used since not always the UE will indicate to the SCG that it no longer has a preference for SCG concerning overheating. Such misalignment can be exemplified in the EN-DC cases below:

1. UE indicates a preference for MCG and SCG configuration concerning overheating, but later it wants to express solely a preference for the MCG configuration concerning overheating while it no longer has a preference for SCG concerning overheating;
2. UE indicates a preference for MCG and SCG configuration concerning overheating, but later it wants to express solely a preference for the SCG configuration concerning overheating while it no longer has a preference for MCG concerning overheating;
3. UE indicates a preference for MCG and SCG configuration concerning overheating, but later it no longer experiences overheating (i.e. it would no longer have any preference for MCG or SCG concerning overheating);

For case A, the UE will, when it no longer has preferences for the SCG concerning overheating, send *overheatingAssistanceForSCG* (without any fields therein) within *OverheatingAssistance* IE.

For case B, it should result in sending *OverheatingAssistance* IE containing only *overheatingAssistanceForSCG* (which would contain the UE preferences for SCG regarding overheating),i.e. without including the fields that indicate preference for MCG*.*

But for case C, the UE will not include *overheatingAssistanceForSCG* within *OverheatingAssistance* IE, it will actually send *OverheatingAssistance* without any fields therein*.* Hence, it is not clear how the SN will be informed that the UE no longer has preferences for the SCG concerning overheating in case C, since the MN will not receive an *overheatingAssistanceForSCG*.

1. It is not clear in all cases for overheating in EN-DC how the SN is informed that the UE no longer has preferences for the SCG concerning overheating.

It should also be noted that if the SN is not informed that the UE no longer has preferences for the SCG concerning overheating (or it no longer experiences overheating at all), the SN will have no means to understand that there is no further restriction concerning overheating and may keep the UE with a downgraded SCG configuration.

1. If the SN is not informed that the UE no longer has preferences for the SCG concerning overheating, the SN may keep the UE with a downgraded SCG configuration.

To address the issue above concerning overheating for the SCG, the following solutions 1 and 2 were outlined in [2]. Another possibility (solution 3) is also described below.

* Solution 1:
* As long as the MN receives *overheatingAssistanceForSCG* IE from UE, MN should store and include *overheatingAssistanceForSCG* IE in every CG-ConfigInfo sent to SN.
* If the SN receives a *CG-ConfigInfo* whichdoes not include *overheatingAssistanceForSCG* IE, the SN considers the UE no longer has preferences for the SCG concerning overheating (e.g. the MN sends *CG-ConfigInfo* without including *overheatingAssistancForSCG* because the MN has received from the UE an *OverheatingAssistance* IE without *overheatingAssistancForSCG*).
* Solution 2:
* When the MN receives *OverheatingAssistance* IE including *overheatingAssistanceForSCG* from UE. MN will forward it to SN, but the MN does not store it. This means for follow-up X2 messages, MN will not include *overheatingAssistanceForSCG* in *CG-ConfigInfo* unless it receives a new one from UE. This also implies that for the SN to be aware that the UE no longer has preferences for the SCG concerning overheating, whenever the UE no longer has such preferences, it should report to the MN *overheatingAssistanceForSCG* with no fields therein.
* Solution 3:
* When the MN receives *OverheatingAssistance* IE including *overheatingAssistancForSCG* from UE. MN will forward it to SN, but the MN does not store it. This means for follow-up X2 messages, MN will not include *overheatingAssistanceForSCG* in *CG-ConfigInfo* unless it receives a new one from UE. Furthermore, when the MN receives from the UE an *OverheatingAssistance* IE without any fields therein (i.e. the UE no longer experiences overheating), the MN includes a new field (to be introduced in 38.331) to indicate to the SN that the UE no longer has a preference for the SCG concerning overheating.
* Companies are also invited to provide further solutions.

Note that all the solutions would require further changes in 38.331(and in 36.331 in case of solution 2), i.e. both network behaviour and UE behaviour may need to be corrected. For instance, in case of solution 2, it should be noted that not always the SN currently gets the UE report of *overheatingAssistanceForSCG* as explained above, hence, if solution 2 is adopted the UE behaviour would have to be corrected to always include the SCG field *overheatingAssistanceForSCG*, when configured to provide overheating report to both MN and SN in EN-DC. The changes associated to each solution are provided in Annex B.

1. Depending on the solution adopted, both network behaviour and UE behaviour may need to be corrected.

**Question 1: Which solution is preferred by companies?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Solution 1/2/3** | **Comments** |
| Huawei, HiSilicon (Yiru) | Solution 2 or Solution 4 | Solution 1 is not preferred due to extra signaling overhead, Solution 2 is preferred compared with Solution 3, since the same logic is used, i.e. the SCG restriction concerning overheating is not needed anymore if the *CG-ConfigInfo* includes an empty *overheatingAssistanceSCG-r16*. But this solution introduces the NBC changes to UE.Besides, we provide a Solution 4:* When the MN receives *OverheatingAssistance* IE including *overheatingAssistancForSCG* from UE. MN will forward it to SN, but the MN does not store it. This means for follow-up X2 messages, MN will not include *overheatingAssistanceForSCG* in *CG-ConfigInfo* unless it receives a new one from UE. Furthermore, when the MN receives from the UE an *OverheatingAssistance* IE without any fields therein (i.e. the UE no longer experiences overheating), **the MN generates a new CG-ConfigInfo including an overheatingAssistanceSCG-r16 with all subfields absent (an empty IE)** to indicate to the SN that the UE no longer has a preference for the SCG concerning overheating.

In this soluiton, the same logic between MN and SN for no preference on SCG configuration is used, and the impacts on the spec and UE behavior are minimized.There is another ASN.1 issue we just found, the IE *overheatingAssistanceForSCG-r16* is not optional,OverheatingAssistance-v1610 ::= SEQUENCE { overheatingAssistanceForSCG-r16 OCTET STRING}which is obviously not aligned with the current procedural text: 3> do not include *reducedUE-Category*, *reducedMaxCCs* and *overheatingAssistanceForSCG* (if configured to provide overheating assistance indication for NR SCG) in *OverheatingAssistance* IE;It was optional field in the agreed CR R2-2006276 but the “optional“ was removed in Draft\_36331-g10\_v2 version. If Solution 2 is preferred, currrent ASN.1 seems OK. If Solution 4 is preferred, “optional“ needs to be added. As it impacts ASN.1 change, we are open to hear companies‘ views. |
| QCOM | Solution-2 | Solution-1 is inefficient Solution-3 seems as a work-around to avoid changes at the UESolution-2 is preferred as it unified the overheating procedural behaivor for NR cells.  |
| MediaTek | Solution-2 (with further clarifiocan) | Solution 2 seems more reasonable although it may have some NBC concerns. We however prefer to have unified rule that empty of the fields in IE *OverheatingAssistance* (within IE *OverheatingAssistanceForSCG*) implies that 1) UE does not suffer for overheating or 2) UE has no preference to limit SCG configuration even in overheating scenario.To clarify, we think Solution-2 implies that (in case overheating is not detected anymore)* UE to report LTE UE assitance information and include *overheatingAssistanceForSCG* which containes **empty** NR IE *OverheatingAssistance*
* Empty implies that IE *OverheatingAssistance* exist without any optional sub-fields.

Furthermore, we believe that the draft TP in Annex B for solution 2 should be further updated.The propsoed change in 36.331 should be 2> else (if the UE no longer experiences an overheating condition):3> do not include *reducedUE-Category*~~,~~ and *reducedMaxCCs* ~~and~~ *~~overheatingAssistanceForSCG~~* ~~(if configured to provide overheating assistance indication for NR SCG)~~ in *OverheatingAssistance* IE;3> if configured to provide overheating assistance indication for NR SCG:4> include *overheatingAssistanceForSCG* in the *OverheatingAssistance* IE;4> set *overheatingAssistanceForSCG* in accordance with clause 5.7.4.3a as specified in TS 38.331 [82];And the last else part in 38.331 should be 2> else (if the UE no longer experiences an overheating condition):3> do not include *reducedMaxCCs*, *reducedMaxBW-FR1*, *reducedMaxBW-FR2*, *reducedMaxMIMO-LayersFR1* and *reducedMaxMIMO-LayersFR2* in *OverheatingAssistance* IE; |
| Ericsson | Solution 2 | We also would think it is better to keep the overheating principle consistent – this should also avoid problems in the future without having to handle two different mechanisms.  |
| ZTE (LiuJing) | Solution 2  | We also prefer solution 2 as it makes the principle consistent for both Uu and X2 interfaces. Regarding Solution 4, we think it works from network implementation point of view. However, the overheatingAssistanceSCG-r16 field is defined as a container(OCTECT STRING), which means it is not supposed to be generated by MN, so solution 4 may be not spec compliant. In addition, for Solution 2, the proposed changes from MediaTek make sense to us.  |
| Nokia, Nokia Shanghai Bell | Solution 2 | We believe first indication on overheating should result in some immediate action by MN, so that it should not store the overheating context for SN for later. In case, the UE does not experience remedy after first indication, it will send following assistance information (including SN related parameters, in case problem will still remain for SN) |
| Apple | Solution 2 | We also feel it’s good to have an aligned solution in various cases (i.e., power saving), that the absence of fiedls indicates no prefernece at all.The text change from MediaTek is fine to us. |
| Samsung | Solution 1 | **Radio interface**: We think solution 2 is not consistent with previous agreements and we see no real need to change at this stage. I.e. we think it was agreed that there is just one overheating feature and that, given that we have no delta for subfields of feature, absence of SCG assistance means that UE has no preference anymore and previous values are cleared. In that sense, absence of SCG assistance is same as presence with subfields absent**Internode signalling**: according to 11.2.3 delta signalling does not apply for overheatingAssistanceForSCG. This means that MN has to keep the latest signalled value and include it in every cg-ConfigInfo. We see no real need to change/ optimiseNote that we think that introducing delta signalling for this inter-node signaling will not have much gain as SCG reconfigurations during overheating would be infrequent |
| CATT | Solution 2 | Solution 2 is simple as it doesn’t require MN to store overheating info for SCG, and it achieves the consistent understanding, i.e. SN also considers that *overheatingAssistanceForSCG* with no fields means the UE no longer has preferences for the SCG concerning overheating. |
| Xiaomi | Solution 2 | Our preference is for consistent and aligned behaviour for the signalling to remove the restrictions on the NR SCG configuration. Solution 2 enables this by the UE consistently sending the overheatingAssistanceForSCG IE with no contents. However as pointed out by Samsung the MN has to keep the latest signalled value for overheatingAssistanceForSCG and include it in every cg-ConfigInfo, so in the case of adopting solution 2 it seems further clairification may be required to the inter node signalling and the storage at the MN. |
| LG | Solution1 | We think solution 2 should be discouraged because it is NBC to UEs and other BC approachs like solution1 and 3 are available.  |

From the input received above, 9 companies would prefer Solution 2 (while 1 of those compabies would also support Solution 4), and 2 companies would prefer solution 1. In case solution 2 is adopted, further clarification to solution 2 is needed (as commented by companies above), namely the following aspects:

To clarify, we think Solution-2 implies that (in case overheating is not detected anymore)

* UE to report LTE UE assitance information and include *overheatingAssistanceForSCG* which containes **empty** NR IE *OverheatingAssistance*
* Empty implies that IE *OverheatingAssistance* exist without any optional sub-fields.

Furthermore, we believe that the draft TP in Annex B for solution 2 should be further updated.

The propsoed change in 36.331 should be

2> else (if the UE no longer experiences an overheating condition):

3> do not include *reducedUE-Category*~~,~~ and *reducedMaxCCs* ~~and~~ *~~overheatingAssistanceForSCG~~* ~~(if configured to provide overheating assistance indication for NR SCG)~~ in *OverheatingAssistance* IE;

3> if configured to provide overheating assistance indication for NR SCG:

4> include *overheatingAssistanceForSCG* in the *OverheatingAssistance* IE;

4> set *overheatingAssistanceForSCG* in accordance with clause 5.7.4.3a as specified in TS 38.331 [82];

And the last else part in 38.331 should be

2> else (if the UE no longer experiences an overheating condition):

3> do not include *reducedMaxCCs*, *reducedMaxBW-FR1*, *reducedMaxBW-FR2*, *reducedMaxMIMO-LayersFR1* and *reducedMaxMIMO-LayersFR2* in *OverheatingAssistance* IE;

If solution 1 is adopted, since no particular comments were given to the current solution 1 formulation, it seems the proposed changes for solution 1 in Annex B would be fine.

Therefore, RAN2 should further discuss the down selected solutions 1 and 2.

1. RAN2 to decide between solution 1 or 2 to address overheating for SCG in EN-DC.

## 2.1 NR-DC

Given the discussion for EN-DC, it can be good to clarify whether companies have the same understanding on the overheating framework for NR-DC.

For NR-DC case, the UE sends an overheating report solely for the MN and based on this report the MN may trigger further coordination with the SN according to the fields below:

[[

 p-maxNR-FR1-MCG-r16 P-Max OPTIONAL,

 powerCoordination-FR2-r16 SEQUENCE {

 p-maxNR-FR2-MCG-r16 P-Max OPTIONAL,

 p-maxNR-FR2-SCG-r16 P-Max OPTIONAL,

 p-maxUE-FR2-r16 P-Max OPTIONAL

 } OPTIONAL,

 nrdc-PC-mode-FR1-r16 ENUMERATED {semi-static-mode1, semi-static-mode2, dynamic} OPTIONAL,

 nrdc-PC-mode-FR2-r16 ENUMERATED {semi-static-mode1, semi-static-mode2, dynamic} OPTIONAL,

 maxMeasSRS-ResourceSCG-r16 INTEGER(0..maxNrofCLI-SRS-Resources-r16) OPTIONAL,

 maxMeasCLI-ResourceSCG-r16 INTEGER(0..maxNrofCLI-RSSI-Resources-r16) OPTIONAL,

 maxNumberEHC-ContextsSN-r16 INTEGER(0..65536) OPTIONAL,

 allowedReducedConfigForOverheating-r16 OverheatingAssistance OPTIONAL,

 maxToffset-r16 T-Offset-r16 OPTIONAL

 ]]

|  |
| --- |
| *CG-ConfigInfo* field descriptions |
| ***alignedDRX-Indication***This field is signalled upon MN triggered CGI reporting by the UE that requires aligned DRX configurations between the MCG and the SCG (i.e. same DRX cycle and on-duration configured by MN completely contains on-duration configured by SN). |
| ***allowedBC-ListMRDC***A list of indices referring to band combinations in MR-DC capabilities from which SN is allowed to select the SCG band combination. Each entry refers to:- a band combination numbered according to *supportedBandCombinationList* and *supportedBandCombinationList-UplinkTxSwitch* in the *UE-MRDC-Capability* (in case of (NG)EN-DC), or according to *supportedBandCombinationList* and *supportedBandCombinationListNEDC-Only* in the *UE-MRDC-Capability* (in case of NE-DC), or according to *supportedBandCombinationList* in the UE-NR-Capability (in case of NR-DC),- and the Feature Sets allowed for each band entry. All MR-DC band combinations indicated by this field comprise the MCG band combination, which is a superset of the MCG band(s) selected by MN. |
| ***allowedReducedConfigForOverheating***Indicates the reduced configuration that the SCG is allowed to configure.*reducedMaxCCs* in *allowedReducedConfigForOverheating* indicates the maximum number of downlink/uplink PSCell/SCells that the SCG is allowed to configure. This field is used in (NG)EN-DC and NR-DC.*reducedMaxBW-FR1* and *reducedMaxBW-FR2* in *allowedReducedConfigForOverheating* indicates the maximum aggregated bandwidth across all downlink/uplink carriers of FR1 and FR2, respectively that the SCG is allowed to configure. This field is only used in NR-DC.*reducedMaxMIMO-LayersFR1* and *reducedMaxMIMO-LayersFR2* in *allowedReducedConfigForOverheating* indicates the maximum number of downlink/uplink MIMO layers of each serving cell operating on FR1 and FR2, respectively that the SCG is allowed to configure. This field is only used in NR-DC. |

Therefore, in NR-DC case, there is no overheating report sent from the MN to the SN, the MN simply may restrict the SN configuration using the fields above. Hence, the MN should always notify the SN about overheating restrictions towards the SCG with *allowedReducedConfigForOverheating*, which basically means that absence of such indication would imply that there is no restriction towards the SCG.

1. For NR-DC, there is no overheating report sent from the MN to the SN and thus the MN should notify the SN about overheating restrictions towards the SCG with *allowedReducedConfigForOverheating*.

Note, however, that the MN signals *allowedReducedConfigForOverheating* to the SN inside *configRestrictInfo*, and according to 38.331, the latter field is not always transmitted, i.e. absence of *configRestrictInfo* does not mean that there is no restriction towards the SN, the restrictions should be kept by the SN until a new *configRestrictInfo* is provided to the SN.

For the other fields in *CG-Config* and *CG-ConfigInfo*, the sender shall always signal the appropriate value even if same as indicated in the previous RRC INM, unless explicitly stated otherwise. As an exception to this general rule, the absence of the below listed fields means that the receiver maintains the values informed via the previous message. Note that every time there is a change in the configuration covered by a listed field, the MN shall include the field and it shall provide the full configuration provided by that field. Otherwise, if there is no change, the field can be omitted:

- *configRestrictInfo*;

Therefore, the overheating behavior for NR-DC should result in the understanding below:

* Once the MN sends *CG-ConfigInfo>configRestrictInfo> allowedReducedConfigForOverheating* to the SN, the SN should account for restrictions in the SCG concerning overheating. As long as the MN does not send any further *CG-ConfigInfo* to the SN containing the field *configRestrictInfo*, such restrictions concerning the SCG should still apply, including for overheating.
* If the SN receives a *CG-ConfigInfo>configRestrictInfo* whichdoes not include *allowedReducedConfigForOverheating*, the SN considers the UE no longer has preferences for the SCG concerning overheating (e.g. the MN sends *CG-ConfigInfo>configRestrictInfo* without including *allowedReducedConfigForOverheating* because the MN has received from the UE an *OverheatingAssistance* IE without any fields therein).

The above is basically the principle of the overall restrictions signalled in *configRestrictInfo*. Hence, there is no change needed to account for it. If companies are aligned on this aspect, it may be sufficient to simply confirm this behaviour in meeting notes.

1. For overheating in NR-DC, the field *allowedReducedConfigForOverheating* should work in the same way as any other restrictions signaled within *CG-ConfigInfo*>*configRestrictInfo*.

**Question 2: Do companies agree with the understanding above?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes | OK to simply confirm this behaviour in meeting notes. |
| QCOM | Yes |  |
| MediaTek | Yes |  |
| Ericsson | Yes |  |
| ZTE | Yes |  |
| Nokia, Nokia Shangai Bell | Yes |  |
| Apple | Yes |  |
| Samsung | Yes | We agree that delta signalling applies for configRestrictInfo and its sub-fields, including allowedReducedConfigForOverheating (and see no need for any change regarding this)Note that in general we see no real need to introduce changes to further align EN-DC and NR DC as anyhow the overall architecture/ handling of overheating is quite different between these cases |
| CATT | Yes |  |
| Xiaomi | Yes |  |
| LG | Yes |  |

All the companies that provided input agree with the understanding highlighted in observation 6. As previously mentioned, there is no change needed for this and it is an expected to be merely confirmed. Hence, it is sufficient to capture it in meeting notes.

1. RAN2 to confirm that for overheating in NR-DC, the field *allowedReducedConfigForOverheating* should work in the same way as any other restrictions signaled within *CG-ConfigInfo*>*configRestrictInfo*.

# 3 Conclusion

In the previous sections we made the following observations:

[Observation 1 The current UE behaviour for EN-DC in Rel-16 can already result in the report of overheating including *overheatingAssistanceForSCG* without any fields therein.](#_Toc61018136)

[Observation 2 It is not clear in all cases for overheating in EN-DC how the SN is informed that the UE no longer has preferences for the SCG concerning overheating.](#_Toc61018137)

[Observation 3 If the SN is not informed that the UE no longer has preferences for the SCG concerning overheating, the SN may keep the UE with a downgraded SCG configuration.](#_Toc61018138)

[Observation 4 Depending on the solution adopted, both network behaviour and UE behaviour may need to be corrected.](#_Toc61018139)

[Observation 5 For NR-DC, there is no overheating report sent from the MN to the SN and thus the MN should notify the SN about overheating restrictions towards the SCG with *allowedReducedConfigForOverheating*.](#_Toc61018140)

[Observation 6 For overheating in NR-DC, the field *allowedReducedConfigForOverheating* should work in the same way as any other restrictions signaled within *CG-ConfigInfo*>*configRestrictInfo*.](#_Toc61018141)

Based on the discussion in the previous sections we propose the following:

[Proposal 1 RAN2 to decide between solution 1 or 2 to address overheating for SCG in EN-DC.](#_Toc61018122)

[Proposal 2 RAN2 to confirm that for overheating in NR-DC, the field *allowedReducedConfigForOverheating* should work in the same way as any other restrictions signaled within *CG-ConfigInfo*>*configRestrictInfo*.](#_Toc61018123)

# References

1. R2-2010543, UE indication when it no longer experiences overheating, Ericsson, RAN2#112-e, November 2-13
2. R2-2011176, [AT112-e][029][NR TEI16] Misc Corrections II, ZTE Corporation, RAN2#112-e, November 2-13

# 5 Annex

## 5.1 Annex A

**UE behaviour for EN-DC in case it no longer experiences overheating for SCG in Rel-16.**

(From TS 36.331)

The UE shall set the contents of the *UEAssistanceInformation* message for overheating assistance indication:

1> if configured to provide overheating assistance indication:

2> if the UE experiences internal overheating:

3> if the UE prefers to temporarily reduce its DL category and UL category:

4> include *reducedUE-Category* in the *OverheatingAssistance* IE;

4> set *reducedUE-CategoryDL* to the number to which the UE prefers to temporarily reduce its DL category;

4> set *reducedUE-CategoryUL* to the number to which the UE prefers to temporarily reduce its UL category;

3> if the UE prefers to temporarily reduce the number of maximum secondary component carriers:

4> include *reducedMaxCCs* in the *OverheatingAssistance* IE;

4> set *reducedCCsDL* to the number of maximum SCells the UE prefers to be temporarily configured in downlink;

4> set *reducedCCsUL* to the number of maximum SCells the UE prefers to be temporarily configured in uplink;

3> if configured to provide overheating assistance indication for NR SCG:

4> include *overheatingAssistanceForSCG* in the *OverheatingAssistance* IE;

4> set *overheatingAssistanceForSCG* in accordance with clause 5.7.4.3a as specified in TS 38.331 [82];

2> else (if the UE no longer experiences an overheating condition):

3> do not include *reducedUE-Category*, *reducedMaxCCs* and *overheatingAssistanceForSCG* (if configured to provide overheating assistance indication for NR SCG) in *OverheatingAssistance* IE;

As depicted in the highlighted procedure above, the *overheatingAssistanceForSCG* may be included, but if there are no preferences for the SCG regarding overheating, the procedures in 5.7.4.3a in 38.331 will result in an *overheatingAssistanceForSCG* without any fields therein.

(From TS 38.331)

#### 5.7.4.3a Setting the contents of *OverheatingAssistance* IE

The UE shall set the contents of *OverheatingAssistance* IE if initiated to provide overheating assistance indication for SCG in (NG)EN-DC according to clause 5.6.10.3 as specified in TS 36.331 [10]:

1> if the UE prefers to temporarily reduce the number of maximum secondary component carriers for SCG:

2> include *reducedMaxCCs* in the *OverheatingAssistance* IE;

2> set *reducedCCsDL* to the number of maximum SCells of the SCG the UE prefers to be temporarily configured in downlink;

2> set *reducedCCsUL* to the number of maximum SCells of the SCG the UE prefers to be temporarily configured in uplink;

1> if the UE prefers to temporarily reduce maximum aggregated bandwidth of FR1 for SCG:

2> include *reducedMaxBW-FR1* in the *OverheatingAssistance* IE;

2> set *reducedBW-FR1-DL* to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all downlink carriers of FR1 of the SCG;

2> set *reducedBW-FR1-UL* to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all uplink carriers of FR1 of the SCG;

1> if the UE prefers to temporarily reduce maximum aggregated bandwidth of FR2 for SCG:

2> include *reducedMaxBW-FR2* in the *OverheatingAssistance* IE;

2> set *reducedBW-FR2-DL* to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all downlink carriers of FR2 of the SCG;

2> set *reducedBW-FR2-UL* to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all uplink carriers of FR2 of the SCG;

1> if the UE prefers to temporarily reduce the number of maximum MIMO layers of each serving cell operating on FR1 for SCG:

2> include *reducedMaxMIMO-LayersFR1* in the *OverheatingAssistance* IE;

2> set *reducedMIMO-LayersFR1-DL* to the number of maximum MIMO layers of each serving cell operating on FR1 of the SCG the UE prefers to be temporarily configured in downlink;

2> set *reducedMIMO-LayersFR1-UL* to the number of maximum MIMO layers of each serving cell operating on FR1 of the SCG the UE prefers to be temporarily configured in uplink;

1> if the UE prefers to temporarily reduce the number of maximum MIMO layers of each serving cell operating on FR2 for SCG:

2> include *reducedMaxMIMO-LayersFR2* in the *OverheatingAssistance* IE;

2> set *reducedMIMO-LayersFR2-DL* to the number of maximum MIMO layers of each serving cell operating on FR2 of the SCG the UE prefers to be temporarily configured in downlink;

2> set *reducedMIMO-LayersFR2-UL* to the number of maximum MIMO layers of each serving cell operating on FR2 of the SCG the UE prefers to be temporarily configured in uplink;

## 5.2 Annex B

### Solution 1: Proposed changes for 38.331

|  |
| --- |
| *CG-ConfigInfo* field descriptions |
| ***overheatingAssistanceSCG***Contains the UE's preference on reduced configuration for NR SCG to address overheating. This field is only used in (NG)EN-DC. The absence of this field indicates that the UE does not have a preference on reduced configuration for NR SCG to address overheating. |

### Solution 2: Proposed changes for 36.331

#### 5.6.10.3 Actions related to transmission of *UEAssistanceInformation* message

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* omitted unchanged parts \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

The UE shall set the contents of the *UEAssistanceInformation* message for overheating assistance indication:

1> if configured to provide overheating assistance indication:

2> if the UE experiences internal overheating:

3> if the UE prefers to temporarily reduce its DL category and UL category:

4> include *reducedUE-Category* in the *OverheatingAssistance* IE;

4> set *reducedUE-CategoryDL* to the number to which the UE prefers to temporarily reduce its DL category;

4> set *reducedUE-CategoryUL* to the number to which the UE prefers to temporarily reduce its UL category;

3> if the UE prefers to temporarily reduce the number of maximum secondary component carriers:

4> include *reducedMaxCCs* in the *OverheatingAssistance* IE;

4> set *reducedCCsDL* to the number of maximum SCells the UE prefers to be temporarily configured in downlink;

4> set *reducedCCsUL* to the number of maximum SCells the UE prefers to be temporarily configured in uplink;

3> if configured to provide overheating assistance indication for NR SCG:

4> include *overheatingAssistanceForSCG* in the *OverheatingAssistance* IE;

4> set *overheatingAssistanceForSCG* in accordance with clause 5.7.4.3a as specified in TS 38.331 [82];

2> else (if the UE no longer experiences an overheating condition):

3> do not include *reducedUE-Category*, *reducedMaxCCs* (if configured to provide overheating assistance indication for NR SCG) in *OverheatingAssistance* IE;

3> include *overheatingAssistanceForSCG* in the *OverheatingAssistance* IE;

3> set *overheatingAssistanceForSCG* in accordance with clause 5.7.4.3a as specified in TS 38.331 [82];

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* omitted unchanged parts \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

### Solution 2: Proposed changes for 38.331

#### 5.7.4.3a Setting the contents of *OverheatingAssistance* IE

1> if the UE experiences internal overheating:

2> if the UE prefers to temporarily reduce the number of maximum secondary component carriers for SCG:

3> include reducedMaxCCs in the OverheatingAssistance IE;

3> set reducedCCsDL to the number of maximum SCells of the SCG the UE prefers to be temporarily configured in downlink;

3> set reducedCCsUL to the number of maximum SCells of the SCG the UE prefers to be temporarily configured in uplink;

2> if the UE prefers to temporarily reduce maximum aggregated bandwidth of FR1 for SCG:

3> include reducedMaxBW-FR1 in the OverheatingAssistance IE;

3> set reducedBW-FR1-DL to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all downlink carriers of FR1 of the SCG;

3> set reducedBW-FR1-UL to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all uplink carriers of FR1 of the SCG;

2> if the UE prefers to temporarily reduce maximum aggregated bandwidth of FR2 for SCG:

3> include reducedMaxBW-FR2 in the OverheatingAssistance IE;

3> set reducedBW-FR2-DL to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all downlink carriers of FR2 of the SCG;

3> set reducedBW-FR2-UL to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all uplink carriers of FR2 of the SCG;

2> if the UE prefers to temporarily reduce the number of maximum MIMO layers of each serving cell operating on FR1 for SCG:

3> include reducedMaxMIMO-LayersFR1 in the OverheatingAssistance IE;

3> set reducedMIMO-LayersFR1-DL to the number of maximum MIMO layers of each serving cell operating on FR1 of the SCG the UE prefers to be temporarily configured in downlink;

3> set reducedMIMO-LayersFR1-UL to the number of maximum MIMO layers of each serving cell operating on FR1 of the SCG the UE prefers to be temporarily configured in uplink;

2> if the UE prefers to temporarily reduce the number of maximum MIMO layers of each serving cell operating on FR2 for SCG:

3> include reducedMaxMIMO-LayersFR2 in the OverheatingAssistance IE;

3> set reducedMIMO-LayersFR2-DL to the number of maximum MIMO layers of each serving cell operating on FR2 of the SCG the UE prefers to be temporarily configured in downlink;

3> set reducedMIMO-LayersFR2-UL to the number of maximum MIMO layers of each serving cell operating on FR2 of the SCG the UE prefers to be temporarily configured in uplink;

2> else (if the UE no longer experiences an overheating condition):

3> do not include *reducedUE-Category*, *reducedMaxCCs* in the *OverheatingAssistance* IE;

### Solution 3: Proposed changes for 38.331

#### – *CG-Config*

This message is used to transfer the SCG radio configuration as generated by the SgNB or SeNB. It can also be used by a CU to request a DU to perform certain actions, e.g. to request the DU to perform a new lower layer configuration.

Direction: Secondary gNB or eNB to master gNB or eNB, alternatively CU to DU.

*CG-Config* message

-- ASN1START

-- TAG-CG-CONFIG-START

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* omitted unchanged parts \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

CG-Config-v1620-IEs ::= SEQUENCE {

 ueAssistanceInformationSCG-r16 OCTET STRING (CONTAINING UEAssistanceInformation) OPTIONAL,

 nonCriticalExtension CG-Config-v16xy-IEs OPTIONAL

}

CG-Config-v16xy-IEs ::= SEQUENCE {

 overheatingAbsenceSCG-r16 ENUMERATED {true} OPTIONAL,

 nonCriticalExtension SEQUENCE {} OPTIONAL

}

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* omitted unchanged parts \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

-- TAG-CG-CONFIG-STOP

-- ASN1STOP

|  |
| --- |
| *CG-ConfigInfo* field descriptions |
| ***overheatingAbsenceSCG*** This field indicates that the UE no longer has a preference for NR SCG to address overheating. |