**3GPP TSG-RAN WG3 #114e** ***Draft R3-215864***

**Online, 1st – 11th November 2021**

**Agenda Item: 14.3**

**Source: Lenovo, Motorola Mobility (Moderator)**

**Title: Summary of offline discussion on CPAC**

**Document for: Discussion and Approval**

# 1 Introduction

**CB: # MRDC3\_CPAC**

**- Check RAN2 progress**

**- Support preparation of single T-SN in SN initiated inter-SN CPC first to progress, and then discuss how to prepare multiple T-SNs as second priority? Check RAN2 progress and focus on open issues from last meeting**

**- CPAC replace and cancel procedure?**

**- Capture agreements as stage2/stage3 CRs and check details, split work, if needed**

**- List open issues for next meeting in the summary**

(Lenovo - moderator)

Summary of offline disc R3-215864

The offline discussion will comprise 2 phases

* Phase 1: Try to identify easy agreements and controversial issues for Phase 2 discussion
	+ **Deadline: November 3rd, Wednesday, 4am UTC**
* Phase 2: Further discuss, e.g., CPAC replace/cancel signalling design, and try to come up with TP if agreeable
	+ **Deadline: November 9th, Tuesday, 4am UTC**

# 2 For the Chairman’s Notes (Phase 1)

# 3 Discussion (Phase 1)

## 3.1 RAN3 impacts considering RAN2 progress

In this section, moderator tries to analyse the possible RAN3 impacts considering RAN2 progress in their last meeting and discuss appropriate RAN3’s action accordingly.

In LS [R3-214697](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_114-e%5CDocs%5CR3-214697.zip), RAN2 informs RAN3 about the following agreements on RRC container design from candidate target SN to MN and execution condition handling at MN during SN initiated inter-SN CPC.

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| [**R3-214697**](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_114-e%5CDocs%5CR3-214697.zip)**:****Inter-node RRC container design:**RAN3 Question:* *About the inter-node RRC container design*
	+ *In case multiple PSCells are prepared in one CPAC procedure, RAN3 would like to ask RAN2 to feedback on the inter-node RRC container design: will one RRC container for one PSCell be used, or one RRC container for multiple PSCells?*

RAN2 feedback:RAN2 has concluded that the configuration of multiple PSCell candidates can be included within a single RRC inter-node message during CPAC procedures from the candidate target SN to the MN.**Execution conditions at SN initiated inter-SN CPC**RAN3 Question:* *About the SN initiated inter-SN CPC, RAN3 would like to ask RAN2 to feedback on the following two alternatives:*
	+ *Alternative 1: MN performs the association between the execution condition received from the source SN and the RRC configuration of the candidate PSCell received from the candidate SN.*
	+ *Alternative 2: MN forwards the execution condition received from the source SN to the candidate SN. The candidate SN sends the execution condition and the RRC configuration of the candidate PSCell to the MN.*

RAN2 feedback:RAN2 has concluded that the MN associates the execution condition configuration to an *RRCReconfiguration* message provided by the target SN. The MN does not need to comprehend the execution condition set by the source SN. FFS if T-SN is informed of the execution conditions. |

As agreed by RAN2, one candidate target SN will send one single RRC container to MN including the configuration of multiple PSCell candidates. In the meanwhile, more detailed RRC signalling design is still under discussion in RAN2 [1], e.g., if a new inter-node RRC message is needed and if the accepted target PSCell IDs will be provided outside CG-Config but within the same RRC inter-node message from target SN to MN.

In the email discussion report [1] which will be discussed in the ongoing RAN2#116e meeting, the following proposals are suggested reflecting majority companies’ view.

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| **R2-2109871 Report for Inter-node message design:**Proposal 1: Introduce a new inter-node RRC message that includes the full list of CG-Config(s).Proposal 2: Specify the accepted target PSCell identity (frequency and PCI) outside the corresponding CG-Config in the new inter-node message.Proposal 3: Send an LS to RAN3 to inform about the new inter-node RRC message that includes a full list of CG-Config(s), and the corresponding impact to RAN3 specification. |

With respect to RAN3 impact, in moderator’s understanding, three aspects related to Xn message design could be worth checking.

***Issue 1: New inter-node RRC message added to SN Addition Request Acknowledge***

First, if a new inter-node RRC message (e.g., CG-CandidateList) is introduced to include the full list of CG-Config(s), the new message will be added as another option for S-NG-RAN node to M-NG-RAN node Container, for instance as proposed in [2]:

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| 9.1.2.2 S-NODE ADDITION REQUEST ACKNOWLEDGEThis message is sent by the S-NG-RAN node to confirm the M-NG-RAN node about the S-NG-RAN node addition preparation.Direction: S-NG-RAN node → M-NG-RAN node.

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| --- | --- | --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description | Criticality | Assigned Criticality |
| Message Type | M |  | 9.2.3.1 |  | YES | reject |
| M-NG-RAN node UE XnAP ID | M |  | NG-RAN node UE XnAP ID9.2.3.16 | Allocated at the M-NG-RAN node | YES | reject |
| S-NG-RAN node UE XnAP ID | M |  | NG-RAN node UE XnAP ID9.2.3.16 | Allocated at the S-NG-RAN node | YES | reject |
| [...] |
| S-NG-RAN node to M-NG-RAN node Container | M |  | OCTET STRING | Includes the *CG-Config* message or the *CG-CandidateList* defined in subclause 11.2.2 of TS 38.331 [10]. | YES | reject |
| [...] |

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***Issue 2: The need of “List of Prepared PSCell IDs” in SN Addition Request Acknowledge***

Secondly, in the previous RAN3 meeting, RAN3 agreed to introduce “List of Prepared PSCell IDs” in SN Addition Request ACK message let MN be aware of the prepared PSCells IDs by reading Xn message without opening the RRC container.

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| Introduce “List of Prepared PSCell IDs” in SN Addition Request ACK.  |

At the same time, RAN2 agreed, as in the LS, it is MN that associates the execution condition configuration to an RRCReconfiguration message provided by the target SN, which implies the MN may anyway open the RRC container to associate the execution condition and SN RRC reconfiguration. Besides, to reduce the complexity and avoid reading the CG-Config, [2] also proposes to specify the accepted target PSCell identity (frequency and PCI) outside the corresponding CG-Config in the new inter-node message (e.g., CG-CandidateList). As such, MN does not need to open the CG-Config to understand the prepared PSCells. The RRC message may look like following as discussed in [2]

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| CG-CandidateList-IEs ::= SEQUENCE { cg-CandidateList-r17 SEQUENCE (SIZE (1..FFS)) OF CG-CandidateInfo-r17 OPTIONAL, nonCriticalExtension SEQUENCE {} OPTIONAL}CG-CandidateInfo-r17 ::= SEQUENCE {ssbFrequency ARFCN-ValueNR,physCellId PhysCellId,candidateCG-Config OCTET STRING (CONTAINING CG-Config)} |

Considering RAN2’s agreement and the inter-node RRC message design proposals, from moderator’s perspective, if RAN2 agrees that the prepared PSCell IDs will be contained in the inter-node RRC message but outside CG-Config, is it still necessary to include the “List of Prepared PSCells IDs” in the part of Xn message as agreed by RAN3 before. Both designs are aiming to reduce the complexity at MN in similar manner, which seems a bit replicated.

***Issue 3: Signaling exchange between MN and Source SN before configuring UE***

For SN initiated inter-SN CPC, RAN2 agreed a working assumption in their last meeting to support solution 2, i.e., MN will receive updated configuration from source SN before sending the RRC message to UE [3]. An exemplary procedure is provided in Figure 1.

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| RAN2#115e Agreement* Working assumption: We go for solution 2. Should make sure multiple re-negotiation procedures (i.e. two nested procedures or anything that requires negotiation cannot be used) is not allowed. Inform RAN3 and take their feedback into account.
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**Figure 1: Exemplary procedure for solution 2 (modified from [4])**

In the exemplary procedure for solution 2, MN uses message 4 to inform source SN about the accepted candidate PSCells, then source SN uses message 5 to update the source SN configuration (e.g., execution condition), and MN will inform source SN about SN RRC complete using message 8. Depending on RAN2 progress, if solution 2 is agreed, what exact Xn messages are message 4, 5, 8 is worth RAN3 discussion. There seems to be two possible options:

* Option 1:
	+ Message 4: SN change confirm
	+ Message 5: SN modification required
	+ Message 8: SN modification confirm
* Option 2:
	+ Message 4: SN modification request
	+ Message 5: SN modification response
	+ Message 8: SN change confirm

In addition, if RAN3 agrees with Option 2 above, the following RAN3 agreement shall be revisited. Since if Option 2 is adopted, the list of prepared PSCells IDs is conveyed in Message 4 SN modification request instead of SN Change Confirm.

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| **RAN3#113e Agreement:**- Introduce “List of Prepared PSCell IDs” in SN Change Confirm. |

In the following question, to ensure companies to be on the same page, companies are asked to confirm the possible RAN3 impact which has RAN2 dependency as analyzed above. RAN3 can wait for RAN2 conclusion before further discussion, i.e., RAN3 will not discuss the relevant issues in this meeting.

**Question 1: To align companies understanding, companies are kindly asked to confirm if the following RAN3 aspects depend on RAN2 progress and thus shall wait for RAN2 conclusion first.**

1. **May modify SN Addition Requestion Ack message to include a new inter-node RRC message containing full list of CG-Config(s) if introduced by RAN2**
2. **May revisit previous RAN3 agreement “Introduce “List of Prepared PSCell IDs” in SN Addition Request ACK” if RAN2 agrees to provide prepared PSCells ID within the new inter-node RRC message but outside CG-Config**
3. **For SN initiated CPC, if RAN2 agrees to support solution 2, RAN3 discusses the signaling design for MN to receive updated configuration from source SN before sending the RRC message to UE. May revisit previous RAN3 agreement “Introduce “List of Prepared PSCell IDs” in SN Change Confirm.”**

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| **Company** | **1)2)3)** | **Comments** |
| ZTE | Agree with 1,2 | For 3, so far it is WA other than agreement in RAN2, so RAN3 can wait for RAN2 progress until it is agreement and stable. |
| Nokia | Agree with 1,2,3, but details are FFS | As written, the general principles of all 3 points are good and need to be addressed. But details (e.g. if a new container is needed, or existing reused) are to be discussed further. |
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## 3.2 Issues related to CPA

NOTE: Moderator observes some mixed use of “CPAC replace” and “Add prepared PSCells” which is sometimes confusing. Thus, it could be beneficial to clarify the difference between “CPAC replace” and “Add prepared PSCells”. In this email discussion, inheriting the spirit from last meeting discussion [13], moderator assumes:

* + “CPAC replace” means updating/modifying previously provided CPAC configuration before CPAC execution.
	+ “Add prepared PSCells” means prepare extra PSCell(s) after CPAC is configured and before CPAC execution.
	+ “CPAC cancel” means cancelling previously prepared PSCell(s) and relevant configuration.

In moderator’s understanding, in order to change a prepared PSCell to another, one needs to trigger “Add prepared PSCells” and “CPAC cancel” at the same time. “CPAC replace” serves different purpose than changing a prepared PSCell to another.

It’s suggested to take above definition for the sake of discussion for the time being, and RAN3 can discuss later if “Add prepared PSCells” and “CPAC cancel” can be considered as part of “CAPC replace” and the relevant signaling design.

Phase 1 discussion focuses on CPAC principles while the exact signaling design is left to phase 2 depending on the progress.

In the last meeting, RAN3 agreed that for CPA, target SN can trigger replace and cancel of prepared PSCells in the T-SN.

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| For CPA, the T-SN can trigger replace and cancel of prepared PSCells in the T-SN. |

In the submitted contributions [5][6][7][8][9], companies believe MN can also trigger replace and cancel of prepared PSCells in the target SN. Besides, [6] also believes that after CPA configuration target SN can trigger adding prepared PSCells within the limit given by MN. However, [12] thinks allowing target SN to add extra prepared PSCells during CPA replace is unnecessary and only adds complexity.

[10][14] believe MN can also trigger the procedure to add prepared PSCell(s), however, in moderator’s understanding MN can only modify the list of suggested candidate PSCell(s) as part of CPAC replace, while technically MN cannot add prepared PSCell(s). Maybe some clarification from companies is needed.

**Question 2: Companies are kindly asked if MN can trigger the following after CPA is configured?**

1. **CPA replace (i.e., modifying previously provided CPA related configurations)**
2. **CPA cancel**
3. **Add prepared PSCells (Please clarify how it is done)**

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| **Company** | **1)2)3)** | **Comments** |
| ZTE | Yes for 1) and 2) | For 1) the MN can modify the “Maximum Number of PSCells To Prepare” IE via MN initiated SN modification procedure.For 2), if MN decides to cancel all of CPA, then the legacy MN initiated SN release procedure can be reused without enhancement. |
| Nokia | 1 (partially) and 2 (partially) | The red line is that **the MN can’t decide on particular PSCells** – this is up to the SN (like in the addition, where it decides which PSCells are to be prepared). With this in mind we understand that 1 and 2 are acceptable:1) The MN may modify the preparation condition, e.g. provide new measurements from the UE or new max number of cells to prepare.2) The MN may force the SN to release some preparations by limiting the max number of PSCells to prepare. It may also release completely CPA to the target SN. |
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**Question 3: Companies are kindly asked if target SN can add prepared PSCells within the limit given by the MN after CPA is configured?**

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| **Company** | **Yes/No** | **Comments** |
| ZTE | Yes |  |
| Nokia | Yes |  |
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## 3.3 Issues related to MN initiated inter-SN CPC

In the last meeting, RAN3 agreed that for MN initiated inter-SN CPC, target SN can trigger replace and cancel of prepared PSCells in the T-SN.

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| For MN initiated inter-SN CPC, the T-SN can trigger replace and cancel of prepared PSCells in the T-SN, while the S-SN cannot trigger replace and cancel. |

Similar as the discussion for CPA replace, some companies [7][8][10] think MN can also trigger CPC replace and cancel in case of MN initiated inter-SN CPC.

**Question 4: Companies are kindly asked if MN can trigger the following after MN initiated inter-SN CPC is configured?**

1. **CPC replace**
2. **CPC cancel**
3. **Add prepared PSCells (please clarify how it is done)**

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| **Company** | **1)2)3)** | **Comments** |
| ZTE | Yes for 1) and 2) | Same as question 2 |
| Nokia | Same as Q2 | Same as Q2. In general, the MN to target SN communication in case of CPC shall follow the same principles as CPA. |
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**Question 5: Companies are kindly asked if target SN can add prepared PSCells within the limit given by the MN after MN initiated inter-SN CPC is configured?**

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| **Company** | **Yes/No** | **Comments** |
| ZTE | Yes |  |
| Nokia | Same as Q2 | Same as Q2. In general, the MN to target SN communication in case of CPC shall follow the same principles as CPA. |
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One issue raised by companies is, in case the CPC is cancelled either by target SN or MN (if supported), shall MN inform source SN about it. [6][10][12] believe it could be beneficial since source SN will at least cancel the ongoing early data forwarding.

**Question 6: Companies are kindly asked that in MN initiated inter-SN CPC does MN need to inform SN about the CPC cancel triggered by target SN or MN (if supported)?**

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| **Company** | **Yes/No** | **Comments** |
| ZTE | Yes | The SN shall be notified, then early data forwarding if configured can be stopped by this indicator |
| Nokia | Yes | This can be left FFS, but seems needed, e.g. to stop data forwarding. |
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## 3.4 Issues related to SN initiated inter-SN CPC

In the previous meeting, RAN3 has made the following working assumption.

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| WA: In case of SN initiated inter-SN CPC, prepare multiple PSCells in one target SN by one SN Change procedure is the baseline. |

However, it is still under debate if that is the best solution since one SN change procedure preparing single target SN would imply parallel preparations for multiple target SNs is allowed. [2] thinks allowing parallel preparation procedures for different target SNs will delay the whole procedure by waiting for the acknowledge messages from all the target SNs. In addition, the interaction of open parallel procedures will cause complexity to the state machine and error handling of network node. [15] thinks one SN change procedure can only prepare one target SN. [11] suggests to first support preparation of single T-SN in SN initiated inter-SN CPC first to progress, and then discuss how to prepare multiple T-SNs as second priority.

**Question 7: Companies are kindly asked in SN initiated inter-SN CPC one SN change procedure can be used to prepare PSCells in one single target SN or multiple target SNs?**

1. **One single target SN**
2. **Multiple target SNs**
3. **RAN3 considers 1) for the time being**

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| **Company** | **1)2)3)** | **Comments** |
| ZTE | 2) | Based on the WA from RAN2, the option 2) is better. In the previous RAN3 meetings, we worried about the complicated early data forwarding, but if RAN2’s WA changed to agreement, the data forwarding issue is not existed. In detail, as seen in figure1, the early data forwarding is handled after step 5. So that, multiple target SNs configured in one SN change required message is more efficient than many SN change required message. |
| Nokia | 3 | So far, option 1 seems easier from RAN3 perspective, so we would prefer to keep it. We can come back to this question once RAN2 confirms the WA. |
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In the previous meeting, RAN3 agreed the following

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| For SN initiated inter-SN CPC, the T-SN can trigger replace and cancel of prepared PSCells in the T-SN. |

Similar as the case for CPA and MN initiated inter-SN CPC, the following questions are asked regarding CPC replace/cancel for SN initiated inter-SN CPC.

**Question 8: Companies are kindly asked if MN can trigger the following after SN initiated inter-SN CPC is configured?**

1. **CPC replace**
2. **CPC cancel**
3. **Add prepared PSCells (please clarify how it is done)**

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| **Company** | **1)2)3)** | **Comments** |
| ZTE | Maybe 1) and 2) based on RAN2 WA. | We suggest to discuss SN initiated CPC as low priority because RAN2’s WA is not stable. For 1) the MN can modify the “Maximum Number of PSCells To Prepare” IE via MN initiated SN modification procedure.For 2), if MN decides to cancel all of CPA, then the legacy MN initiated SN release procedure can be reused without enhancement. |
| Nokia | Same as Q2 | Same as Q2. In general, the MN to target SN communication in case of CPC shall follow the same principles as CPA.Please note, even in case of SN-initiated CPC, the MN may have own reasons to cancel DC operation towards the target SN. Then, for (1) and (2), the MN must be allowed to transfer requests from the source SN. |
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**Question 9: Companies are kindly asked if source SN can trigger the following after SN initiated inter-SN CPC is configured?**

1. **CPC replace**
2. **CPC cancel**
3. **Add prepared PSCells (please clarify how it is done)**

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| **Company** | **1)2)3)** | **Comments** |
| ZTE | Maybe 1) and 2) based on RAN2 WA. | We suggest to discuss SN initiated CPC as low priority because RAN2’s WA is not stable.  |
| Nokia | 1 (partially) and 2 (partially) | The red line is that **the source SN can’t decide on particular PSCells** – this is up to the target SN (like in the classic SN change, where it decides which PSCells are to be prepared). With this in mind we understand that 1 and 2 are acceptable:1) The source SN may modify the preparation condition, e.g. provide new measurements from the UE or new max number of cells to prepare.2) The source SN may force the target SN to release some preparations by limiting the max number of PSCells to prepare. It may also ask the MN to release completely CPC to the target SN. |
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**Question 10: Companies are kindly asked if target SN can add prepared PSCells within the limit given by the source SN after SN initiated inter-SN CPC is configured?**

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| **Company** | **Yes/No** | **Comments** |
| ZTE | Yes based on RAN2 WA. | We suggest to discuss SN initiated CPC as low priority because RAN2’s WA is not stable. |
| Nokia | Yes | We’re fine to have it as FFS |
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**Question 11: Companies are kindly asked that in SN initiated inter-SN CPC does MN need to inform SN about the CPC cancel triggered by target SN or MN (if supported)?**

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| **Company** | **Yes/No** | **Comments** |
| ZTE | Yes |  |
| Nokia | Yes |  |
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## 3.5 Other issues

Another issue raised by couple of companies [16] is that, even though RAN3 made the following agreement to introduce new X2AP message to let MN inform source SN about “CPC triggered”/”CPC executed”, in another RAN3 discussion (see R3-212741) about CHO in EN-DC it has been agreed that in the case of MN to eNB/gNB Change, for CHO with EN-DC, the existing X2AP Data Forwarding Address Indication procedure is used to initiate/stop early data forwarding. Thus, [16] suggests to revert previous agreement and follow the principle from CHO in EN-DC, i.e., using the existing X2AP class 2 Data Address Indication procedure from MN to inform the source SN about “CPC triggered”.

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| In case of MN initiated inter-SN CPC, introduce new X2AP class 2 procedure from MN to inform the source SN about “CPC triggered”.In case of SN initiated inter-SN CPC, using a class 2 procedure in both X2AP and XnAP to indicate “CPC executed”. For X2, a new class2 procedure is introduced.  |

Although [16] focuses on “CPC triggered”, moderator believes the same issue applies to “CPC executed” indication over X2AP.

**Question 12: Companies are kindly asked if X2AP class 2 Data Address Indication procedure can be used for MN to inform the source SN about**

1. **“CPC triggered” and ”CPC executed” for MN initiated inter-SN CPC**
2. **“CPC executed” for SN initiated inter-SN CPC**

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| **Company** | **1)2)** | **Comments** |
| ZTE | Yes for 1) and 2) | We agree with both |
| Nokia | Yes for both |  |
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# 3 Conclusion

# Reference

[1]R2-2109871 Report for Inter-node message design Ericsson

[2] R3-214767 (TP for CPAC BL CR to TS 38.423) Inter-node message and Support of SN-initiated CPC Ericsson

[3] R2-2108831 RAN2-115-e LTE 71 GHz DCCA Multi-SIM and RAN slicing (Tero)\_2021-08-27-EOM2

[4] R2-2103109 Summary of [Post113-e][234][eDCCA] CPAC procedures (CATT)

[5] R3-214748 (TP for CPAC BL CR to TS 37.340) Remaining issues for MN initiated CPC ZTE

[6] R3-214809 (TP to CPAC BL CR to 38.423, LTE\_NR\_DC\_enh2-Core) Max number of PSCells, cancellation and modification of a CPAC Nokia, Nokia Shanghai Bell

[7] R3-214920 CPAC replace procedures Qualcomm Incorporated

[8] R3-215328 Left issues on CPAC Lenovo, Motorola Mobility

[9] R3-215527 Open issues on CPAC replace and cancel LG Electronics

[10] R3-214749 (TP for CPAC BLCR to TS36.423/TS38.423) CPA and CPC replace and cancel ZTE

[11] R3-215109 (TP to 37.340 CPAC BL CR) Support of inter-SN CPC Huawei

[12] R3-215113 Further Considerations on Conditional PSCell ChangeAddition CATT

[13] R3-214304 Summary of Offline Discussion on MRDC3\_CPAC Huawei

[14] R3-215527 Open issues on CPAC replace and cancel LG Electronics

[15] R3-214943 (TP for CPAC BL CR to TS 36.423 ) On CPAC (Conditional PSCell Addition and PSCell Change) NEC

[16] R3-214747 (TP for CPAC BLCR to TS36.423) Reusing X2AP Data Forwarding Address Indication procedure for Early data forwarding ZTE, Qualcomm Incorporated, Lenovo, Ericsson

# Annex