3GPP TSG-RAN WG2 Meeting #113bis Electronic R2-21xxxxx

Online, 12 -20 April 2021

**Agenda item:**

**Source: CATT**

**Title: Summary of [Post113-e][234][eDCCA] CPAC procedures (CATT)**

**WID/SID: LTE\_NR\_DC\_enh2-Core - Release 17**

**Document for: Discussion and Decision**

# 1 Introduction

This is the report for the following email discussion:

[Post113-e][234][eDCCA] CPAC procedures (CATT)

Scope: Continue discussion on CPAC procedures, including P1-4 from R2-2101970 and CPAC/CHO coexistence. Attempt to provide Stage-2 signalling flows for CPAC procedures.

Intended outcome: Discussion report + Stage-2 TP

Deadline: Long- 26th March 2021 @ 1100 UTC

Rapporteur plans to have an intermediate deadline on the discussion of solutions (phase 1). This is to understand solutions and identify any issue associated with the solutions(s).

Phase 1 deadline: 5th March 2021 @ 1100 UTC

Phase 2 deadline: 26th March 2021 @ 1100 UTC

# 2 Discussion

**2.1 Phase 1: Discussion of solutions for SN initiated inter-SN CPC**

At RAN2\_112-e meeting, the following agreement was made on SN initiated inter-SN CPC.

**Proposal 1: Option 1 should be used for the generation of conditional reconfiguration for SN initiated inter-SN conditional PSCell change.**

**Option 1: The MN generates CPC. The source SN sets the execution condition and communicates it to the MN. The MN generates the conditional reconfiguration message including the execution condition(s) provided by the source SN and RRCReconfiguration provided by the candidate PSCell(s).**

As discussed in R2-2010734, Figure 1 is an illustration of signaling flow for SN initiated Inter-SN CPC based on Option 1. The figure follows the steps used in a conventional SN initiated SN change procedure as shown in Figure 10.5.1-2 of TS37.340. Note that Figure 1 shows the signaling flow up to the signaling of the conditional configuration for SN initiated Inter-SN CPC to the UE. Signaling upon the execution of CPC is not shown in the figure as the main focus of this discussion is on the generation of conditional reconfiguration for SN initiated Inter-SN CPC.

In this solution, the MN generates a CPC configuration, i.e., the IE *ConditionalReconfiguration* as an MN configuration based on reconfiguration per target candidate (denoted RRCReconfiguration\*\* in Figure 1) and the execution condition per candidate cell. RRCReconfiguration\*\* per target candidate is provided by each target candidate cell in response to a conditional SN Addition Request. The execution condition per candidate cell is provided by the S-SN in the conditional SN Change Required.



**Figure 1: Configuration of SN-initiated inter-SN CPC based on agreement.**

**Steps 1:** Based on e.g. RRC measurement report received from the UE, source SN decides to initiate the CPC procedure. Source SN determines the set of target SNs for the CPC procedure,. The source SN initiates the conditional SN change procedure by sending SgNB Change Required message which contains target SN information, and measurement results related to the target SN. For each candidate target PSCell frequency, source SN determines the CPC execution condition. In the SN Change Required message, source SN provides information relevant to CPC configuration to the MN. In addition to the content of conventional SN Change Required message, CPC execution condition for each candidate target PSCell frequency is included in the SN Change Required message.

**Steps 2:** MN initiates the SN Addition procedure with the set of target SNs indicated in SN Change Required. As a base line, the content of SN addition Request is similar to the conventional SN Addition Request message (how the conditionality of the request is indicated is FFS).

**Step 3:**  The target SN determines the target PSCell and generates RRCReconfiguration\*\* for the selected candidate PSCell and provides it to the MN in SN addition request acknowledgement message. FFS on inclusion of multiple candidate cell configurations.

**Step 4:**  The MN generates an RRCReconfiguration to be provided to the UE including CPC configuration (as an MN configuration), mapping the execution condition configuration to an RRCReconfiguration\*\* provided by the target SN for candidate PSCell.

**Step 5:** the UE provides RRCReconfigurationComplete message to the MN upon reception of RRCReconfiguration message (to confirm the reception of the CPC configuration).

The preparation of execution condition for SN initiated Inter-SN CPC was further discussed in the last meeting, RAN2\_113-e [R2-2101970]. As shown in Figure 1, the source SN provides the execution condition for the target candidate cells(s). The target SN may not accept all the candidate cells which the source SN has provided execution conditions. The MN generates the conditional reconfiguration (in step 4 of Figure 1) by mapping the execution condition(s) and an RRCReconfiguration\*\* provided by the target SN for candidate PSCell.

An issue was identified during last meeting discussion that **the source SN may need to update its configuration depending on the accepted candidate cells by the target SN**. The source SN may have configured the measurements taking into account the execution condition for CPC candidate target cells. However, as the target SN may have only accepted some cells for CPC configuration, there may have some measurement configurations (configured by the source SN) which are no longer is required. For example, if the source SN has configured measurement gaps for measuring a candidate target cell and that cell is not accepted by the target SN for CPC, there remains some unrequired measurement configurations of source SN. Whether this is an issue which needed a standardised solution should be discussed. The severity of the issue depends on frequency of this happening. Also it should consider the UE behaviour in case there is an unrequired measurement configuration.

If this issue to be resolved, there are two solutions which can be considered.

**Solution 1:** The network updates the source SN configuration after step 4 (in Figure 1). In Step 4, the RRC Reconfiguration including the conditional configuration for CPC is sent to the UE. Upon reception of the conditional reconfiguration for CPC, the UE can start evaluating the CPC execution. The source SN prepares the execution condition for CPC without assistant information from the MN or target SN. Signalling flow shown in Figure 1 is applicable for solution 1. The source SN can update its configuration anytime (business as usual) and update the measurement configuration for the UE after step 4, if required.

**Solution 2:** The updated source SN configuration is transmitted to the UE together with conditional configuration for CPC. Referring to Figure 1, after Step 3, the MN provides information on the accepted candidate cells by the target SN to the source SN. Based on the information received from the MN, the source SN updates the source SN configuration and sends it to the MN. The MN generates the conditional reconfiguration for CPC in the same way as in solution 1. The MN generates the final RRC Reconfiguration message to the UE including the conditional reconfiguration for CPC, MN configuration, if required and the updated source SN configuration. Figure 2 illustrates the signalling flow for solution 2.



**Figure 2: the procedure update required for solution 2.**

In Phase 1, rapporteur would like to form a common understanding of the procedure for SN initiated Inter-SN CPC and identify any issue which should be resolved. In order to form an interactive technical discussion (e.g. similar to face-to-face offline discussions), rapporteur welcomes the company opinions on the procedure, the identified issues and solutions in open/ flexible format. The company comments can be included in the below table and reply to a comment/question raised by another company can also be included. At the end of Phase 1, rapporteur aims to provide a list of identified issues.

|  |  |
| --- | --- |
| **Issue** | **Company comment** |
| measId(s) in SCG MeasConfig but not in CPC configuration | **Ericsson**: In Solution 1 the UE may end up configured with measId(s) in SCG MeasConfig associated to PSCell(s) not selected by a target candidate gNodeB i.e. they would not be in the CPC configuration. Maybe this is not a major issue, we can simply define that the UE ignores these measId(s) and not be required to perform measurements accordingly as they are not in CPC and as they are anyway deleted upon suspend/release and successful execution.  In Solution 2 this would not be a problem, as the UE only receives measId(s) in SCG MeasConfig that matches what the target candidate gNodeB(s) have selected. This makes solution 2 slightly better in that perspective, with the cost of an additional network procedure.  Sam> We think this is not a very significant issue. I.e. UE may just briefly have some CPAC related measId configured that are not used by any CPAC candidate that is configured. By step 6, S-SN becomes aware of not accepted candidates and then it can simply remove any reportConfig & measID that are not used in any CPAC configuration. I.e. we think we should not complicate operations, neither by a modified message sequence as in fig2 nor by UE autonomous removal |
| Measurement gap configuration outdated | **Ericsson**: In solution 2 this is not an issue as the MN receives the indication of the accepted frequencies / cells from target candidate gNodeBs and knows which measId(s) per frequency/cell to configure the UE with in SCG MeasConfig, and the required measurement gaps. We could check with RAN3 if they think Solution 2 brings issues in terms of latency and signaling.  However, in solution 1, the UE would first receive a measurement gap that is outdated (perhaps for measuring more frequencies than needed) to almost immediately get an updated version, which is not very nice as two sub-sequence RRC procedures will be triggered (increases signaling) and a gap re-configuration is triggered almost immediately after the UE has setup its first gap configuration.  In a way, it is quite bad that solution 1 leads to the UE to be configured with a wrong configuration to then immediately be re-configured. It is not easy to foresee how often this will happen.  So, if companies insist to have a single network procedure, like in Solution 1, something in between is anyway needed e.g. MN sends the update to S-SN from T-SN about accepted target candidates (cells/frequency) and waits before configuring the UE, at least for some time, to avoid the unnecessary double RRC procedures.  Sam> See our previous remark |
| When to send SgNB Change Confirm message in response to SgNB Change Required (Step 1 in Figure 1) | **[CATT]** As per the legacy procedure, Reception of the SgNB Change Confirm message triggers the source SN to stop providing user data to the UE and, if applicable, to start data forwarding. For CPC, the source SgNB will only stop data transmission to the UE upon the CPC execution. Therefore, we need to discuss when to send the SgNB Change Confirm message to the S-SN, 1) after Step 5 in Figure 1 2) after execution of CPC. |
| which messages can be used for step 4/5 in solution 2 | **[CATT]** solution 2, step 4/5 should be performed prior to transmitting RRCReconfiguration message (step 6) to the UE. however for legacy procedure, SgNB Change Confirm message is transmitted to the S-SN after successful allocation of target SN resources, i.e. after receiving RRCReconfigurationComplete message (step7). We need to discuss which message can be used for step 4/5 in solution 2. And we don’t think the SgNB Change Confirm message can be used for step 4 as suggested by Ericsson. We think SgNB Modification Request can be used for step4, and SgNB Modification Request Acknowledge can be used for step5, |
| Solution 2/ Figure 2 | **[Nokia]** We were encouraged to use flexible and open format of the discussion, so we have inserted several comments already above. However, few remarks also here:  If steps 4 and 5 in Figure 2 are performed anyway (in this example, to update the source SN’s config) then we wonder why there is still a need to send the execution conditions already in Step 1? Due to the possibility the target SN may not prepare cells from the list provided by the source SN and to avoid sending unnecessarily large number of execution conditions, some of which will stay unused, we suggest the execution conditions are sent in Step 5, when the source SN has been informed which cells were accepted and prepared by the target SN**.** |
| Solution 1 | **[Nokia]** It is not clear how Solution 1 solves the problem since the source SN cannot know which PSCells the target SN has finally selected without getting the assistance information from MN. Moreover, providing an updated measurement configuration from the source SN would cause additional signaling. |
| Blind preparation | **[Nokia]** The source PSCell may trigger a blind preparation of target PSCells. In this case, the source SN does not have even measurement to identify the relevant target PSCell candidates. In this case, the source SN shall be informed about the prepared candidate cells to provide the corresponding CPC execution condition as performed in step 4 and 5 of Figure 2. |
| Whether step 4/5 in solution 2 is optional or mandatory? | **[ZTE]** We wonder whether step 4/5 in solution 2 is a mandatory procedure or not? If it’s mandatory, then the execution condition transferred in step1 seems not needed. However, considering the Xn/X2 signalling overhead and transmission latency, we think step 4/5 in solution 2 should be triggered optionally, e.g. in case the target SN selects other candidate PSCells whose execution condition is not provided in step1. Then the MN can initiate the step 4 to request the updated execution condition and meas configuration (if needed). |
| Whether the source configuration update procedure is triggered by the MN or the source SN? | **[ZTE]** Regardingwhich messages can be used for step 4/5 in solution 2, we think the detailed signalling can be discussed in RAN3. But perhaps RAN2 can firstly discuss which node can trigger the source configuration update procedure？If the MN can directly trigger the procedure, then we can consider CATT’s solution (SgNB Modification Request can be used for step4, and SgNB Modification Request Acknowledge can be used for step5). While if it’s up to the SN trigger the update procedure, we can consider to use SgNB Change Confirm (or maybe other Xn/X2 message) in step 4, and then the source SN initiates the SN modification procedure. |
| Whether MN can decide to exclude not accepted cells from source SN configuration | **[LG]** question for the issue:  Before choosing the solution between #1 and #2, we wonder if MN can decide to exclude the cells which are not accepted by the target SN from the source SN configuration. That is, MN sends source SN the updated source SN configuration. Even though RAN2 agreed that MN is not allowed to alter the content of the configuration from the PSCell, it may need to be considered again for this issue. If MN can update the source SN configuration according to the target SN configuration, 2 signalling, step 4 and step 5 in solution #2 can be reduced by 1, i.e. just send updated source SN configuration from MN to the source SN. |
| Candidate generation & conditions | **[Samsung]** We think that S-SN decides the candidates as it determines the condition for each. T-SN may of course not accept some of the candidates suggested by S-SN, but it cannot come up with alternative candidates as suggested by Nokia.  We furthermore think that baseline is that conditions are per candidate, alike in R16. Anything else (e.g. same condition for all candidates on same frequency) seems an optimization/ enhancement  We assumed this was sufficiently clear, but given remarks from Nokia, it seems beneficial to confirm |
| Need for per candidate information | **[Samsung]** We think that a key issue is to identify the inter node information that is per candidate. We assume its clear execution conditions and target configurations are per candidate. However, in previous discussions R2 also considered further information that may depend on the candidate   * Capability coordination info i.e. configuration restrictions exchanged by MN to T-SN e.g. allowedBCs may depend on the candidates * Radio bearer configuration i.e. the amount of SCG resources may differ between candidates on different frequencies and this may affect the DRBs that MN wishes to offload   Correspondingly, there may be a need to transfer per candidate information within SN Addition Request. If confirmed, we need to discuss how to transfer the per candidate information (RRC INM, XnAP) |
| Regarding Solutions 1 and 2, Figures 1 and 2 | **[Qualcomm]** On the issue of forwarding by MN of prepared PSCells received from target SNs to source SN, we think Solution 2, Figure 2, is the correct procedure for CPC, because it would result in the correct measurement gap configuration in CPC configuration provided to the UE, though it comes with additional signaling and delay.  It seems to us that there are two cases to consider: (1) when per-UE measurement gap is configured for the UE, (2) when per-FR measurement gap is configured for the UE. UE indicates through its capabilities whether it supports separate measurement gap configurations for FR1 and FR2, i.e., per-FR measurement gaps.  (1) Per-UE gap is configured for the UE.  In this case, MN decides the gap configuration. Thus, MN does not need to forward the prepared PSCells to source SN and the procedure in Figure 1 applies. After receiving the prepared PSCells from the target SNs, MN determines and provides the gap configuration in CPC configuration message to the UE. MN only includes measIDs corresponding to the prepared PSCells in the CPC configuration message.  (2) Per-FR gap is configured for the UE.  Sub-case (a): EN-DC, NGEN-DC.  In this case, MN decides the gap configuration for FR1, while the SN decides the gap configuration for FR2. Thus, MN should forward the prepared PSCells to the source SN in a message (e.g., SN Change Confirm) and the procedure in Figure 2 applies. Source SN then provides the measurement configuration including FR2 gap configuration to the MN in a message (e.g., SN Modification Required) for the MN to include in CPC configuration message.  Sub-case (b): NR-DC.  In this case, MN decides both the FR1 and FR2 gap configurations. Thus, this case is handled the same way as Case (1) above when per-UE gap is configured.  In summary, Solution 2, Figure 2, is in general the correct procedure, and Solution 1, Figure 1, applies in certain cases.  We also agree with Nokia that in the procedure of Solution 2, Figure 2, there seems to be no need to provide the execution conditions by source SN to MN in SN Change Required. |
| When to send SgNB Change Confirm message in response to SgNB Change Required | **[Qualcomm]** CATT observed that according to the legacy procedure, reception of SN Change Confirm message triggers source SN to stop providing user data to the UE and, if applicable, to start data forwarding.  We think that SN Change Confirm should be used in Step 4 of the procedure of Figure 2, since it is the response message to SN Change Required that requests preparation of CPC. In the specifications we can however indicate that, in case of CPC the source SN does not stop providing user data to the UE upon receiving SN Change Confirm. |
| When to send SgNB Change Confirm message in response to SgNB Change Required (Step 1 in Figure 1) | **[Lenovo]** we think the SN change confirm can be sent after MN getting the responses from target SNs as Ericsson and Nokia indicated. Reception of the SN Change Confirm message triggers the source SN to stop providing user data to the UE and, if applicable, to start data forwarding. However, the legacy does not stop the source SN to communicate RRC configuration related Xn message with MN after receiving the SN Change Confirm as long as the UE context is not released.  In our view, after receiving SN Change Confirm message, if SN wants to modify/update some previous CPC related RRC configuration, SN can still trigger it per e.g. SN modification required message to MN. |
| which messages can be used for step 4/5 in solution 2 | **[Lenovo]** As explained above, we think step 4 can be done per SN Change Confirm, then no need of step 5. |
| CPAC replace | **[Lenovo]** related to the above two comments, we think it is the CPAC replace issue in general we are discussing here. In solution 1 and 2, at the end, it is about source SN modify/replace the previously given CPC configuration. However, there are other scenarios too, e.g. target SN might want to trigger CPAC replace based on the received measurement or due to some CPAC resources change at target SN, and in case target SN triggers CPC replace, shall the source SN be informed if it’s SN initiated CPC? At the end, if we want to support CPAC replace procedure, we might want to take more scenarios into account and design a framework that can work for all scenarios (not only the source SN triggered CPC replace as in solution 1 and 2). |

Summary of Phase 1: identified issues with regards to solutions discussed

Candidate generation & execution conditions

Issue 1: Whether the execution condition is provided by the source SN per candidate cell alike in Rel-16 or not.

Issue 2: Blind preparation: whether it is possible for the source SN to trigger inter-SN CPC blindly. The source PSCell may trigger a blind preparation of target PSCells without measurements.

Issue 3: T-SN may not accept some of the candidates suggested by S-SN. Can the T-SN come up with alternative candidates?

Source SN configuration update

Issue 4: whether the source SN would need to update its configuration depending on the accepted candidate cells by the target SN. Configuration parameters (identified so far) to consider: measId(s) in SCG MeasConfig, Measurement gap configuration (per UE gap, per FR gap). Does the update of the source SN configuration requires always or only in some scenario? How significant the problem and which option to use for source SN configuration update?

Solution 1 details

Issue 5: When to send SgNB Change Confirm message in response to SgNB Change Required (Step 1 in Figure 1)

Solution 2 details

Issue 6: which messages can be used for step 4/5 in solution 2. Whether the source configuration update procedure is triggered by the MN or the source SN in solution 2

Issue 7: when to send execution condition to the MN in solution 2 (in step 1 or step 5 in figure 2)

Issue 8: Whether step 4/5 in solution 2 is optional or mandatory

Issue 9: Whether MN can decide to exclude not accepted cells from source SN configuration, i.e. the MN modifies the SN configuration provided by the source SN

Inter-node message content

Issue 10: what per candidate information is transmitted in SN addition Request (e.g. execution condition, target configuration, capability coordination info, radio bearer configuration, etc)

Conditional configuration update by the target SN

Issue 11: update of the conditional configuration by the target SN.

**2.2 Phase 2 discussion**

### 2.2.1 Procedure for SN initiated inter-SN CPC

**Candidate generation & execution conditions**

***Issue 1: Whether the execution condition is provided by the source SN per candidate cell alike in Rel-16 or not.***

The source SN sets the execution condition and communicates it to the MN. There are at least two different opinions on how the execution condition is set by the source SN.

a) Source SN provides the candidate cells and it sets the execution condition per candidate cell (in step 1 of Figure 1 and 2). The target SN may only accept some of the candidate cells suggested by the source SN. The target SN decides on candidate cells for which measurements were provided for.

b) Source SN provides measurements for candidate cells and execution condition for each frequency on which to configure a candidate cell (in step 1 of Figure 1 and 2). In this case, execution condition is provided per frequency but it is not specific to a particular candidate cell. The target SN decides on candidate cells for which measurements were provided for.

**Question 1: Companies are requested to comment on how the execution condition is set by the source SN.**

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| --- | --- | --- |
| Company | a)/ b) | Comment |
| Nokia | b) if Solution 1 (Figure 1) is to be supported  Ericsson: We don’t think solution 1 works as, even in that case, T-SN may not accept all frequencies requested by the S-SN. | To have the execution condition prepared per cell, it cannot happen in Step 1 of Figure 1. At this stage the exact set of cells to be prepared is not known (no decision taken by target SN). Thus, if solution from Figure 1 is to be supported, we prefer a common condition, to be shared among several potentially prepared cells (could be per frequency, as stated in b). |
| Samsung | a) | We think option a) is baseline  SN change required: In option a) a condition is signalled per candidate while in option b) there can be fewer conditions e.g. one per frequency |
| Ericsson | Solution a) is ok, but we see no reason to forbid measurements to be provided. | Setting per cell is fine, but that still requires S-SN to provide measurements to MN that provides measurements to the T-SN so it can make the decision.  It is important to highlight that the T-SN may decide not to configure all requested cells and/or frequency candidates by S-SN, so that there needs to be a way to handle the non-accepted cells / frequencies in the MN, and the associated execution conditions for these non-accepted cells/ frequencies. The problem is the same, regardless if conditions are set per cell or frequency. |

***Issue 2: Blind preparation: whether it is possible for the source SN to trigger inter-SN CPC blindly.***

It needs to discuss whether SN initiated inter-SN change can be triggered blindly by the source SN. In this case, the source SN does not even have measurements to identify the relevant target PSCell candidates. It is not clear whether it is possible for the source SN to request a target SN for inter-SN CPC without measurement.

**Question 2: Companies are requested to comment on whether it is possible for the source SN to trigger inter-SN PSCell change blindly and should this scenario be considered for SN initiated inter-SN CPC.**

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| --- | --- | --- |
| Company | Blind SN initiated inter-SN CPC is supported or not | Comment |
| Nokia | Supported | There are other reasons than just measurement-based, to trigger the PSCell change. Thus, we should leave this autonomy to target SN. We are obviously not against forwarding the measurement results when they are available and relevant, but the final decision which cell to prepare should be up to the target SN. This should not be confined by any list prepared by MN or source SN. |
| Samsung | Not sure | We think that for blind change is currently not supported for regular/ conventional inter-SN PSCell change and see no real need for CPC to support more.  If it comes for free and for both regular and conditional PSCell change, we are fine |
| Ericsson | Supported | We don’t think we need to discuss network implementation here. What would be the impact in any specification of deciding this here? |

***Issue 3: Target SN may not accept some of the candidates suggested by the Source SN. Can the Target SN come up with alternative candidates?***

If the source SN has suggested candidate cells, can the target SN comes up with alternative candidate cells? Similarly, if the source SN has provided execution condition per frequency, can the target SN come up with a candidate cell on a different frequency where the execution condition is not provided by the source SN?

**Question 3: Companies are requested to comment on whether it is possible for the target SN to come up with alternative candidate cells other than what suggested by the source SN.**

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| --- | --- | --- |
| Company | Alternative candidate cells possible/ not possible | Comment |
| Nokia | Possible | If the execution conditions are prepared later, after the decision taken by the target SN which cells to prepare, there is no problem if the target SN comes up with different cells than initially requested by the source SN. Source SN is not aware of all factors that may impact the decision whether certain cell can become a PSCell candidate (such as load, admission control). This is known to the target SN and target SN should be allowed to provide alternative candidates. Then for such new candidates the condition is either prepared by the source SN after being asked by the MN (Solution 2/Figure 2) or the common execution condition (as discussed in Question 1) is associated. |
| Samsung | No | We think we should stick to agreement that S-SN decides conditions (there are no T-SN configured measurements yet on which conditions can be based). Hence, we think T-SN can only configure alternative candidates if:   1. S-SN provides execution conditions that are suitable the T-SN initiated candidate e.g. a frequency specific condition 2. S-SN provides measurements for the cell (i.e. meaning S-SN provides measurements for cells it did not selected as candidate), or we introduce support for blind CPC by T-SN   We however see no need to support this option |
| Ericsson | Possible | The S-SN provides measurements per cell in a frequency in the RRC container, in the *candidateCellInfoListSN:*  CG-Config-IEs ::= SEQUENCE {  […]  candidateCellInfoListSN OCTET STRING (CONTAINING MeasResultList2NR) OPTIONAL,  […]  }  Even though it is not likely that the T-SN will select a different cell and/or frequency not in that list, we see no reason to prevent that implementation.  If not all target cells and/or frequency candidates are accepted; or, if a new cell / frequency (not requested by S-SN) is added by the T-SN, the MN anyway sends the results from T-SN to S-SN, so the S-SN provides/ updates the SCG MeasConfig and/or the execution conditions per candidate cell/ frequency. In solution 2 this is already built in but works in solution 1 in case we allow an opportunistic approach where MN may wait for these updates before re-configuring the UE with CPC. |

**Source SN configuration update**

***Issue 4: whether the source SN would need to update its configuration depending on the accepted candidate cells by the target SN.***

So far measId(s) in SCG MeasConfig and Measurement gap configuration (per UE gap, per FR gap) are identified as the parameters which may require updating based on the accepted candidate cells by the target SN.

The UE may end up configured with measId(s) in SCG MeasConfig associated to PSCell(s) not selected by a target candidate gNodeB i.e. they would not be in the CPC configuration. However this may not been seen as a major issue, considering that the UE could be requested to ignore these measId(s) and not be required to perform measurements accordingly as they are not in CPC.

Measurement gap configuration could be per UE gap or per FR gap. In some scenarios, the MN decides on the measurement gap configuration. In some other scenarios, the MN and source SN decide on the measurements gap configuration to the UE. If the MN has decided on the measurement gaps for the UE (e.g. per-UE gap, NR-DC), there is no requirement for updating the source SN configuration based on the accepted candidate cells by the target SN. If the source SN has configured measurement gaps (e.g. (NG)EN-DC) for measuring a candidate target cell and that cell is not accepted by the target SN for CPC, there remains some unrequired measurement configurations of source SN. In this case, measurement gap configuration by the source SN may need to be updated based on the accepted candidate cells by the target SN.

**Question 4: Companies are requested to comment on whether the source SN would need to update its configuration depending on the accepted candidate cells by the target SN always? If the source SN configuration update based on the accepted candidate cells by the target SN is required in some scenarios, please state which scenarios require the source SN configuration update.**

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| --- | --- | --- |
| Company | Source SN configuration update required always/ in some scenarios  - which parameters need update | Comment |
| Nokia | Measurement configuration, such as measurement gaps. | The need for such reconfiguration could be identified when the MN contacts the source SN upon the response from the target SN, when it is known which cells have been prepared. Then it would be the right time to prepare corresponding execution conditions and reconfigure the source SN config. |
| Samsung | No strong need, can be done after CPAC configuration and left up to network implementation | We think that T-SN rejection may cause UE to have a configuration that is merely sub-optimal i.e. not really causing problems. Moreover, we assume that rejection is not a very frequent case, so no strong need to optimise the handling  We acknowledge that UE may temporarily be configured with some measId’s with CPC related reportConfig that are not used in any CondReconfig. I.e. some hanging configuration. We think these would not cause any problems but S-SN can cleanup if desired  For gaps, situation is similar i.e. if UE ends up with candidates on fewer frequencies, (S-SN generated) gap configuration may not be entirely optimal.  Note that if T-SN rejects candidates, there may anyhow be a need for S-SN to take further action e.g. add other candidates.. So a subsequent cleanup does not necessarily imply in additional Reconfiguration messages |
| Ericsson | SCG MeasConfig for the measIDs and gap configuration | In some cases the S-SN needs to update the SCG configuration. However, the solution could be that the MN can decide to wait for a new SCG configuration before configuring the UE or it could configure the UE anyway, until a possibly new SCG configuration is updated (these two possibilities could be captured in stage-2).  If both possibilities are supported, we need to define the measId(s) in SCG MeasConfig not linked to CPC candidates are not required to be measured. |

The severity of the issue discussed in question 4 depends on frequency of this happening. Thus whether a standardised solution is required to solve the issue identified in question 5 should be discussed taken into account the frequency of the problem, scenarios, the UE behaviour, etc. There are at least three different solutions to use for removal of the unrequired measurement configuration of source SN based on the accepted candidate cells by the target SN:

a) Remove by source SN Reconfiguration after CPAC configuration/execution.

b) Update of source SN configuration and transmit the updated SN configuration together with conditional configuration . i.e. Introduce additional nested sub-procedure, as in solution 2

c) UE autonomous removal

**Question 5: Companies are requested to comment on which solution is acceptable for removal of the unrequired measurement configuration of the source SN depending on the accepted candidate cells by the target SN.**

|  |  |  |
| --- | --- | --- |
| Company | a)/b)/c) | Comment |
| Nokia | b) | We should not allow for UE autonomous removal of the configuration (i.e. option c). Not clear when option a) happens. Is it about configuration or execution of CPAC? Seems it may lead to another reconfiguration to fix the inappropriate measurement configuration (redundant reconfiguration)? |
| Samsung | a) | See previous  We think R17 CPAC is sufficiently complex already, so we prefer to avoid introducing additional complexity as in option b).  We note that we also have to address several modification cases (e.g. modifications affecting the CPAC candidates), so limited time for further enhancements. |
| Ericsson | None of these solutions are needed | CPC related measConfig will anyway be deleted upon successful execution, as in CHO (and under other scenarios such as suspend, handover, etc.).  The only thing we need is that the UE does not have to measure measId(s) that are not linked in CPC by a candidate. |

**Procedure details**

***Issue 5: When to send SgNB Change Confirm message in response to SgNB Change Required (Step 1 in Figure 1)***

At RAN2\_112-e meeting, the following agreement was made on SN initiated inter-SN CPC.

**Proposal 1: Option 1 should be used for the generation of conditional reconfiguration for SN initiated inter-SN conditional PSCell change.**

**Option 1: The MN generates CPC. The source SN sets the execution condition and communicates it to the MN. The MN generates the conditional reconfiguration message including the execution condition(s) provided by the source SN and RRCReconfiguration provided by the candidate PSCell(s).**

As discussed in R2-2010734, Figure 3 is an illustration of signaling flow for SN initiated Inter-SN CPC based on the above agreement. The figure follows the steps used in a conventional SN initiated SN change procedure as shown in Figure 10.5.1-2 of TS37.340.

The MN generates a CPC configuration, i.e., the IE *ConditionalReconfiguration* as an MN configuration based on reconfiguration per target candidate (denoted RRCReconfiguration\*\* in Figure 3) and the execution condition per candidate cell. RRCReconfiguration\*\* per target candidate is provided by each target candidate cell in response to a conditional SN Addition Request. The execution condition per candidate cell is provided by the Source SN in the conditional SN Change Required.



**Figure 3: Configuration of SN-initiated inter-SN CPC based on agreement.**

Figure 3 doesn’t show the SgNB Change Confirm message in response to SgNB Change required message in step 1. As per the legacy procedure, Reception of the SgNB Change Confirm message triggers the source SN to stop providing user data to the UE and, if applicable, to start data forwarding. For CPC, the source SgNB will only stop data transmission to the UE upon the CPC execution. When to send SgNB Change Confirm message should be discussed for inter-SN CPC. There are three options to consider:

Option 1: SgNB Change Confirm message is transmitted after CPC execution. This option follows the steps used in conventional SN initiated inter-SN PSCell change procedure. Reception of the SgNB Change Confirmation message triggers the source SN to stop data transmission to the UE.

Option 2: SgNB Change Confirm message is transmitted after step 5. In this option, the reception of SgNB Change Confirmation message does not trigger the source SN to stop data transmission to the UE. Therefore, a new indication should be added in SgNB Change Confirmation message to indicate that data transmission to the UE should not be stopped. Also another message from the MN to the source SN is required upon the execution of CPC to inform the source SN to stop data transmission to the UE.

Option 3: SgNB Change Confirm message is transmitted after step 3. Similar to option 2, the reception of SgNB Change Confirmation message does not trigger the source SN to stop data transmission to the UE. Therefore, a new indication should be added in SgNB Change Confirmation message to indicate that data transmission to the UE should not be stopped. Also another message from the MN to the source SN is required upon the execution of CPC to inform the source SN to stop data transmission to the UE.

**Question 6: Companies are requested to comment on which option is acceptable for transmitting SgNB Change Confirm message in response to SN Change Required in Step 1.**

|  |  |  |
| --- | --- | --- |
| Company | a)/b)/c) | Comment |
| Nokia | Option 2, Option 3 | Both Option 3 (step 3a) and Option 2 (step 5a) are acceptable options for transmitting “SgNB Change Confirm”. If Option 3 (step 3a) is adopted, then step 4 of Fig. 4 indicating the accepted candidate cell information from MN to source SN can be combined with “SgNB Change Confirm”.  Step 6a (Option 2/3) could be a useful message as well, as it allows to inform the source SN when to stop transmission and initiate the data forwarding. However, step 6a (Option 1) may be a bit too late for SN Change Confirm and the question (to RAN3) remains how long in the procedure the source SN can wait for such confirmation? |
| Samsung | 1. but | We see no real need to do something different compared to conventional SN initiated inter-SN PSCell change.  We however also think RAN3 typically handles issues related to data forwarding and prefer to leave it to them |
| Ericsson | Option 2) and Option 3), but we also need 2/3 for indicating execution! | Option 2) should be supported in case the S-SN can include in the SN Change Required for CPC the SCG MeasConfig and the execution conditions, and the T-SN candidate accepts all requested candidate cells and/or frequencies (depending how S-SN sets the conditions, if per cell and/or frequency).  That means the MN can first configure the UE with CPC to then receive the RRCReconfigurationComplete including an SCG RRCReconfigurationComplete to be provided to the S-SN in the SN Change Confirm. There is no need to indicate that data transmission is NOT stopped, the S-SN is aware this is for CPC and not legacy.  Option 3) should also be supported in case the S-SN can include in the SN Change Required for CPC the SCG MeasConfig and the execution conditions, and the T-SN candidate does NOT accept all requested candidate cells and/or frequencies (depending how S-SN sets the conditions, if per cell and/or frequency). In that case the MN incudes accepted candidates in the SN Change Confirm to the S-SN before it re-configures the UE (to avoid double RRC signalling), so the S-SN triggers an SN Modification Required with the updated SCG measConfig and execution conditions. Upon reception, the MN generates CPC, configures the UE, receives an RRCReconfigurationComplete including an SCG RRCReconfigurationComplete that is provided from MN to S-SN in the SN Modification Confirm.  Option 2/3) Upon execution the MN needs to indicate that to the S-SN, to some extent as in legacy, so the data forwarding is prepared and S-SN stops data transmissions. The exact message can be agreed in RAN3. |

**Solution 2 details**

If option b) is considered for Question 5 above, the details of solution 2 should be discussed. There are a number of points to be discussed about the solution 2.



**Figure 4: the procedure update required for solution 2.**

***Issue 6: which messages can be used for step 4/5 in solution 2. Whether the source configuration update procedure is triggered by the MN or the source SN in solution 2***

Solution 2 requires introducing an additional nested sub-procedure in step 4 and 5. Even though what messages are to be used for inter-node signalling is within the scope of RAN3, RAN2 agreed to discuss the detail procedure for SN initiated Inter-SN CPC. The use of inter-node sub-procedure may depend on whether the source configuration update procedure is triggered by the MN or the source SN in solution 2.

**Question 7: Companies are requested to comment on which messages can be used for step 4/5 in solution 2. And whether the source configuration update procedure is triggered by the MN or the source SN in solution 2.**

|  |  |  |
| --- | --- | --- |
| Company | Inter-node messages for step4/5 | Comment |
| Nokia |  | RAN3 to decide about the messages to be used. Note that step 4 can be combined with “SgNB Change Confirm” if Option 3 (step 3a) of Fig. 3 is adopted.  SN configuration update should be triggered (if needed) when source SN receives the message in step 4 and knows which cells have been prepared. |
| Samsung | NA | We prefer to leave this to RAN3. We are fine do discuss what RAN2 contents would be included  4: None  5: A single CG-ConfigInfo: only including a non-conditional SCG reconfiguration, replacing the non-conditional SCG reconfiguration in 1)  Although MN initiated modification might be used, given that MN does provide input regarding what SN should change, it seems more like two one-step messages i.e. 5 is not like accept/ reject of 4  BTW: We assume that in this solution there is a need for a further message facilitating data forwarding e.g. alike shown in the previous sequence |
| Ericsson | SN Change Confirm in 4,  SN Modification Required in 5.  Then, SN Modification Confirm is missing in step 8. | Message 4 with the accepted candidates can be the SN Change Confirm, but RAN3 can make a final decision.  Then, message 5 is clearly an SN Modification Required as that needs to include an SCG MeasConfig and the execution conditions.  However, message 8 is missing (probably an SN Modification Confirm). |

***Issue 7: Whether step 4/5 in solution 2 is optional or mandatory***

***Issue 8: when to send execution condition to the MN in solution 2 (in step 1 or step 5 in figure 4)***

Under Issue 4, we discuss scenarios where update of source SN configuration based on the accepted candidate cells by the target SN may be needed. The main parameter identified for update is the measurement gap configuration by the source SN. In some scenarios, source SN configuration update based on the accepted candidate cells by the target SN may not be required. Hence, step4/5 in solution 2 may be considered to be an optional.

One company raised the issue that the source SN could provide the execution condition to the MN in step 5 (in Figure 4) in solution 2 together with the updated source SN configuration. If the step 4/5 in solution 2 is to be considered an optional depending on the scenario, the source SN should provide the execution condition to the MN in step 1.

**Question 8: Companies are requested to comment on whether step 4/5 in solution 2 is optional or mandatory and** **when to send execution condition to the MN in solution 2 (in step 1 or step 5 in figure 4).**

|  |  |  |  |
| --- | --- | --- | --- |
| Company | step4/5 optional/mandatory | When to send execution condition (step1/step5) | Comment |
| Nokia | mandatory | Step5 | For solution 2 to work, we need to have steps 4 and 5 introduced (to obtain the execution conditions and reconfigure the source SN conf.). Execution conditions should be also provided to the MN when it is known which cells have been prepared. |
| Samsung |  |  | As indicated, we prefer to limit complexity and hence not to introduce this solution. Making these steps optional introduces further options, which makes things worse/ increasing complexity. E.g. if conditions can be placed in 5, least complex option is to always be there i.e. with step 4/ 5 mandatory (S-SN needs to know where to place conditions before knowing if some candidates will be rejected) |
| Ericsson | Optional? |  | We don’t want that to be complicated with too many options, but we would prefer not to limit network implementation e.g. the SN Change Required has already the possibility to include the CG-Config (which is the same container that would possibly be included in SN Modification Required), so we don’t think we need to forbid that in specifications. |

**Inter-node message content**

***Issue 9: inter-node message content***

So far we have not discussed the detail of inter-node message content for SN initiated inter-SN CPC from RAN2 point of view. Step 1 to 3 in Figure 1 and 2 are common to both solution 1 and 2. As the starting point, we could discuss what additional parameters are required to realise SN initiated Inter-SN CPC in step 1 (SN Change required), 2 (SN Addition Request) and 3 (SN Addition Request Acknowledge) of Figure 1. Please note that this discussion is to gather RAN2 point of view (e.g. execution condition, target configuration, capability coordination info, radio bearer configuration, etc)

**Question 9: Companies are requested to comment on message content required for step 1, 2 and 3 in Figure 1 to realise SN initiated inter-SN CPC from RAN2 point of view.**

|  |  |
| --- | --- |
| Company | Comment |
| Nokia | In step 1 the execution conditions if solution 1 from Figure 1 is pursued.  Configured bearers and candidate’s measurement results in step 1, 2.  In Step 3 RRC containers with prepared candidate cells + the cell IDs, so that the MN does not have to decode the configurations. |
| Samsung | We think that a key issue is to identify, for each of the inter-node messages, the RRC info/ parameters that need to be signalled and for which a value per UE (**PU**) is sufficient and for which it should e.g. be possible to multiple values e.g. one per individual candidate (**PC**).  For target configurations, it seems clear that a configuration is signalled per candidate. For execution conditions, Q1/3 somewhat address the question whether to have a value per candidate or per frequency. However, in previous discussions R2 also considered further RRC parameters for which per candidate signalling may be required:   1. Capability coordination info i.e. configuration restrictions exchanged by MN to T-SN e.g. allowedBCs may differ depending on the band of the individual candidate 2. Radio bearer configuration i.e. the amount of SCG resources may differ between candidates on different frequencies and this may affect the DRBs that MN wishes to offload   We think this exercise will assist identifying any further stage 2 aspects like a) and b) that need to be concluded. For baseline approach (solution 1), below a starting point is provided.  1 SNChangeReq: execution conditions (PC), measurements of cells (PU), Non-conditional SCG reconfig (PU), Current SCG config (PU), Current selectedBC (PU)  2 SNAdditionReq: selected candidates (PC), measurements of cells (PU), configuration restrictions (for capability coordination, PC), DRBs to establish (PC?), Current SCG config (PU), Current selectedBC (PU)  3 SNAdditionReqAck: admitted candidates (PC), target RRC config (PC), selectedBC (PC), established DRBs (PC?), |
| Ericsson | In most messages legacy info should be supported, but in addition, the SN Change Required and the SN Addition Request need an indication that the procedure is conditional.  Whether step 1 includes execution conditions and the SCG measConfig for CPC, depends if Solution 1 or 2 is adopted. In any case, measurements are included, as in legacy, so that the T-SN candidate can decide the exact candidate cells and frequencies are accepted. |

**Conditional configuration update by the target SN**

***Issue 10: update of the conditional configuration by the target SN.***

This issue was raised during phase 1 of the discussion. As usual, the target SN should be able to update the configuration provided for candidate cells. The solution developed for initial conditional configuration for inter-SN CPC should also be able to use for update of the conditional configuration by the network. If this is not the case and additional requirements are identified for update of conditional configuration, please state below.

**Question 10: If any identified, additional requirements (compared to initial conditional configuration procedure for inter-SN CPC) for update of conditional configuration by the target SN can be commented below.**

|  |  |
| --- | --- |
| Company | Comment |
| Nokia | As far as we know, the topic of modification/update of the conditional reconfiguration, triggered by the target SN, is already discussed in RAN3. Thus, no need to focus on it in RAN2 for the time being. |
| Samsung | We think there is a need to support several other modification cases, alike for CHO. We think these are best discussed after the framework for initial configuration is sufficiently solid  Cancellation: It should be possible for S-SN, MN and T-SN to initiate cancellation of a configured CPAC candidate  Modification: It should be possible or MN and S-SN to update MCG and SCG configuration respectively. This may affect the RRC configuration of CPAC candidates, as generated by T-SN |
| Ericsson | Before discussing update we need to discuss a cancelling use case. That should be supported, though the exact procedure is a RAN3 topic.  When it comes to a modification procedure, that is not necessarily the same as the cancelling (followed by a new addition), that needs to be also discussed in RAN3 (as they also discussed that for CHO). |

### 2.2.2 Coexistence of CHO an CPAC

Configuration of CHO and CPC simultaneously was not supported in rel-16 specification and it was left to network implementation (e.g. OAM) to avoid the CHO and CPC coexistence scenario. The objective was to have only one of CHO or CPAC to be active for a UE at a given time. OAM can make sure only one conditional procedure (CHO vs CPAC) is active at a time.

In the last meeting, it was argued [R2-2101313] if such a restriction is needed in the first place. The need to apply CHO does not rule out the need for CPAC, as one is related to mobility robustness and the other is related to reducing the latency of DC setup. Therefore, it was suggested in [R2-2101313] to consider the support of both CHO and CPAC simultaneously.

**Question 11: Companies are requested to comment on whether to consider the simultaneous support of CHO and CPAC in this WI scope.**

|  |  |  |
| --- | --- | --- |
| Company | Support/ not support | Comment |
| Nokia | Yes | As pointed out above, these two solutions can actually bring different benefits and address separate problems. They can be configured and initiated by different nodes, not necessarily in a fully coordinated manner. Thus, some means for their coexistence should be developed. Alternatively, more predictable way of coordinating whether CPC or CHO is used, should be introduced. |
| Samsung | Can consider | If time allows, we are open to consider some simultaneous configurations. We however think we should focus on improving mobility robustness i.e. primarily consider simultaneous configuration for CHO and (MN and SN initiated) CPC |
| Ericsson | We can get back to this later | We think we should first finish CPAC, then we can talk about optimization and cross-feature interaction. |

If simultaneous CHO and CPAC are supported, there are different scenarios where the combination of CHO and CPAC configuration could be considered at the same time.

Scenario 1: the CHO and CPAC configuration are independent and the UE monitors the triggering conditions for the CHO and CPAC independently.

Scenario 2: A CHO configuration that contains an associated CPAC configuration.

**Question 12: Companies are requested to comment which scenarios to be considered for simultaneous support of CHO and CPAC.**

|  |  |  |
| --- | --- | --- |
| Company | scenario | Comment |
| Nokia | Scenario 1 (1st priority) and Scenario 2 (2nd priority) | If both (CHO and CPAC) are allowed, the UE should be free to monitor and trigger CPC irrespective of whether the CHO evaluations. However, Scenario 2 is also a realistic use case, so should be studied as a second priority (if both are not doable simultaneously). |
| Samsung | 1) | We think that triggers for CHO and CPC can be independent events  We assume scenario 2 concerns a case of CHO with the RRC reconfiguration incuded in condRRCConfig not only including change of PCell but also a reconfiguration of SCG (added or modification) with both being performed upon CHO execution. Adding SCG reconfiguration for conventional HO will increase latency for the HO procedure, which seems undesirable. As CHO is typically configured somewhat earlier, the additional latency seems somewhat less of a concern. However, we think this is more of a *nice to have* kind of enhancement |
| Ericsson | Scenario 2 needs to be clarified. | Scenario 2, from network perspective, is CHO operating with MR-DC i.e. a target MN candidate can add an SCG. |

# 5 Conclusion

# 6 Reference