3GPP TSG-RAN WG2 Meeting #114 Electronic R2-21xxxxx

Online, 2 – 13 November 2020

**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**

# 5 Conclusion

# 6 Reference