3GPP TSG-RAN WG2 Meeting #112 Electronic DRAFT R2-200xxxx

Online, 2 – 13 November 2020

**Agenda item: 8.2.3**

**Source: CATT**

**Title: [Post111-e][920][eDCCA] Conditional PSCell Change and Addition (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:

* [Post111-e][920][eDCCA] Conditional PSCell Change and Addition (CATT)

 Scope: Cover common grounds, e.g. confirm which old R16 agreements can be inherited now as “easy” agreements, and items that might need limited discussion.

 Intended outcome: Report to next meeting

 Deadline: Long - Thursday OCT 15 0700 UTC (please respect this deadline)

In RAN2#111e, the discussions on Conditional PSCell Addition and Change (CPAC) were started for Rel-17. After a brief discussion on the scope of the work, the following initial agreements were made.

* R2 assumes that the work Will follow what is in the WID, and initially focus on CPA and Inter-SN CPC
* R2 assumes for now that LTE SCG is not included.

Following the above agreements, this email discussion **initially focuses on CPA and inter-SN CPC**. NR-DC and (ng)EN-DC deployment scenarios are considered. This includes:

- conditional PSCell addition

- MN initiated Inter-SN conditional PSCell change

- SN initiated Inter-SN conditional PSCell change

Note that the focus of this email discussion is primarily on the CPA and Inter-SN CPC procedures. Intra-SN CPC with MN involvement is not discussed while respecting the last meeting agreement to prioritise CPC and Inter-SN CPC. The intention is to discuss Intra-SN CPC after finalising the procedure for CPA and Inter-SN CPC.

# 2 Discussion

**2.1 Basic procedures**

At the initial discussion of Rel-16, all scenarios for CPAC were considered and some agreements were made. Due to the WI time limitation, Rel-16 scope was narrowed down only to introduce intra-SN conditional PSCell change without MN involvement. It is a good place to start the Rel-17 discussion from the CPAC agreements previously made in Rel-16 discussion.

At RAN2#107bis and RAN2#108 meetings, we have reached some agreements for general CPAC cases as follows:

***RAN2#107bis Chongqing***

**Agreements**

1. We will prioritize work in SN-initiated PSCell change for conditional PSCell change.
2. Maintain Rel-15 principle that only one PScell is active at a time even with conditional PScell addition/change.

2 For conditional PSCell addition, the MN decides on the conditional PSCell addition execution condition. The condition is defined by a measurement identity, given by a measurement configuration provided by the MN.

3 For conditional PSCell change, execution condition may be decided by MN (MN-initiated) or SN (SN-initiated)

4 For conditional PSCell change, A3/A5 execution condition should be supported while for conditional PSCell addition, A4/B1 like execution condition should be supported.

5 For conditional SN change, the source SN configuration can be used as the reference in generation of delta signalling for the candidate SNs.

***RAN2#108 Reno***

**Agreements**

1. CPAC is defined as the UE having network configuration for initiating access to a candidate PSCell, either to consider the PSCell as suitable for SN addition or SN change including intra-SN change, based on configured condition(s).

2. Usage of CPAC is decided by the network. The UE evaluates when the condition is valid.

3. Support configuration of one or more candidate cells for CPAC;

o FFS how many candidate cells (UE and network impacts should be clarified). FFS whether the number of candidate cells for CPAC different from that of CHO.

5. Allow having multiple triggering conditions (using “and”) for CPAC execution of a single candidate cell. Only single RS type per CPAC candidate is supported. At most two triggering quantities (e.g. RSRP and RSRQ, RSRP and SINR, etc.) can be configured simultaneously. FFS on UE capability

6. Define an execution condition for conditional PSCell change by the measurement identity which identifies a measurement configuration There is already an agreement for conditional PSCell addition

7. Cell level quality is used as baseline for Conditional NR PSCell addition/change execution condition;

g. Only single RS type (SSB or CSI-RS) per candidate PSCell is supported for PSCell change.

h. At most two triggering quantities (e.g. RSRP and RSRQ, RSRP and SINR, etc.) can be configured simultaneously. FFS on UE capability.

i. TTT is supported for CPAC execution condition (as per legacy configuration)

8. No additional optimizations with multi-beam operation are introduced to improve RACH performance for conditional PSCell addition/change completion with multi-beam operation.

9. For FR1 and FR2, leave it up to UE implementation to select the candidate PSCell if more than one candidate cell meets the triggering condition. UE may consider beam information in this.

10. UE is not required to continue evaluating the triggering condition of other candidate PSCell(s) during conditional SN execution.

**For PSCell addition:**

4. The baseline operation for CPAC procedure assumes the RRC Reconfiguration message contains SCG addition/change triggering condition(s) and the RRC configuration(s) for candidate target PSCells. The UE accesses the prepared PSCell when the relevant condition is met.

a. Multiple candidate PSCells can be sent in either one or multiple RRC messages.

b. As part of the CPAC configuration to be sent to the UE, the RRC container is used to carry candidate PSCell configuration, and the MN is not allowed to alter any content of the configuration from the PSCell. moreover, in case of SN change, source SN is not allowed to alter any content of the configuration from the target SN.

c. Use add/mod list + release list to configure multiple candidate PSCells.

d. CPAC execution condition and/or candidate PSCell configuration can be updated by modifying the existing CPAC configuration.

e. Reuse the RRCReconfiguration/RRCConnectionReconfiguration procedure to signal CPAC configuration to UE.

FFS handling of conditional SN addition associated to the SN terminated bearer.

**Agreements for CPAC configuration related proposals**

2 For conditional PSCell addition, the MN transmits the final RRCReconfiguration/ RRCConnectionReconfiguration message to the UE, which includes the execution condition generated by the MN, and encapsulates the RRCReconfiguration provided by the candidate PSCells. FFS how the encapsulation is done exactly (can be considered in Stage-3)

3 SN decides on the condition for SN-initiated procedures and MN decides on the condition on MN-initiated procedures.

FFS whether we need coordination on exact execution conditions or just measurements.

FFS whether source or target SN knows the condition

FFS in which exact cases the condition needs to be indicated

5 Both the execution condition and the configuration for the candidate PSCell (as a container) can be included in the RRCReconfiguration message generated by the SN for intra-SN conditional PSCell change initiated by the SN (without MN involvement).

6 SRB1 can be used in all cases. SRB3 may be used to transmit conditional PSCell change configuration to the UE for intra-SN change without MN involvement.

The agreements above are mostly related to the general procedure for CPAC, e.g. the configuration of execution condition(s), the generation and transmission of CPAC configuration. In order to avoid the repetitive discussion for general CPAC procedure in Rel-17, the agreements reached in RAN2#107bis and RAN2#108 can be confirmed first.

**Question 1: Companies are requested to comment on applicability of the agreements for CPAC general procedure reached in RAN2#107bis and RAN2#108.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Whether the above agreements are applicable or not?** | **Comments** |
| Nokia | Majority seems to apply, but some need further discussion or are not yet relevant (e.g. Stage-3 details). | Any FFS from the table above, should be discussed directly now, in Rel-17.These two should be also left out:*5 Both the execution condition and the configuration for the candidate PSCell (as a container) can be included in the RRCReconfiguration message generated by the SN for intra-SN conditional PSCell change initiated by the SN (without MN involvement).**6 SRB1 can be used in all cases. SRB3 may be used to transmit conditional PSCell change configuration to the UE for intra-SN change without MN involvement.*As they concern the case when no MN involvement is considered, while in Rel-17 we tend to address cases with MN involvement as well (the case without MN’s role was addressed in Rel-16).The following agreement is also not needed in Rel-17:*0 We will prioritize work in SN-initiated PSCell change for conditional PSCell change.*A further discussion is needed on whether the stated measurement events are sufficient for CPA and CPC.Finally, such decision as how many CPC/CPA candidate cells there are supported should be postponed to Stage-3 stage of the work item.  |
| Ericsson | Partly | RAN2#107bis: 0 is not relevant for rel-17.RAN2#108: b and 4 for PSCell addition need some clarification and modification. The important thing is in which format the message is that contains the conditions and the message to be applied, if it is in MN format or SN format. We think it needs to be in MN format as it contains sk-Counter and bearer configurations. Also, agreement 2 for CPAC configuration needs this clarification. The other agreements seem fine. |
| MediaTek | In principle ok | However, we also agree that some of these agreement are not applicable to R17. The FFS point is not necessary to capture. Some of the stage 3 details are already implemented for CPC (e.g. most of the agreement in RAN2#108), not sure why we need to repeat this again in R17. In our understanding, extending the CPC to inter-SN case should NOT change the signalling in UU interface too much. Proposed agreement for **CPA**From RAN2#107bis* Maintain Rel-15 principle that only one PSCell is active at a time even with conditional PSCell addition/change.
* For conditional PSCell addition, the MN decides on the conditional PSCell addition execution condition. The condition is defined by a measurement identity, given by a measurement configuration provided by the MN.
* For conditional PSCell addition, A4/B1 like execution condition should be supported.

From RAN2#108 (First set)* CPA is defined as the UE having network configuration for initiating access to a candidate PSCell, to consider the PSCell as suitable for SN addition based on configured condition(s).
* Usage of CPA is decided by the network. The UE evaluates when the condition is valid.
* Support configuration of one or more candidate cells for CPA.
* Allow having multiple triggering conditions (using “and”) for CPA execution of a single candidate cell. Only single RS type per CPA candidate is supported. At most two triggering quantities (e.g. RSRP and RSRQ, RSRP and SINR, etc.) can be configured simultaneously.
* Cell level quality is used as baseline for Conditional NR PSCell addition execution condition;
* At most two triggering quantities (e.g. RSRP and RSRQ, RSRP and SINR, etc.) can be configured simultaneously.
* TTT is supported for CPA execution condition (as per legacy configuration)
* No additional optimizations with multi-beam operation are introduced to improve RACH performance for conditional PSCell addition completion with multi-beam operation.
* For FR1 and FR2, leave it up to UE implementation to select the candidate PSCell if more than one candidate cell meets the triggering condition. UE may consider beam information in this.
* UE is not required to continue evaluating the triggering condition of other candidate PSCell(s) during conditional SN execution.

From RAN2#108 (Second Set)* The baseline operation for CPA procedure assumes the RRC Reconfiguration message contains SCG addition/change triggering condition(s) and the RRC configuration(s) for candidate target PSCells. The UE accesses the prepared PSCell when the relevant condition is met.
* Multiple candidate PSCells can be sent in either one or multiple RRC messages.
* As part of the CPA configuration to be sent to the UE, the RRC container is used to carry candidate PSCell configuration, and the MN is not allowed to alter any content of the configuration from the PSCell.
* Use add/mod list + release list to configure multiple candidate PSCells.
* CPA execution condition and/or candidate PSCell configuration can be updated by modifying the existing CPA configuration.
* Reuse the RRCReconfiguration/RRCConnectionReconfiguration procedure to signal CPA configuration to UE.

From RAN2#108 (Third Set)* For conditional PSCell addition, the MN transmits the final RRCReconfiguration/ RRCConnectionReconfiguration message to the UE, which includes the execution condition generated by the MN, and encapsulates the RRCReconfiguration provided by the candidate PSCells.

For **inter-SN CPC**, for the signaling and procedure in Uu interface, we should reuse as much as possible from intra-SN CPC. So, probably it is sufficient to say that “the design of UU interface for intra-SN CPC procedure is reused as baseline for inter-SN CPC procedure”. |
| Samsung | Mostly agreeable (see summary) | We think it’s better if previous agreements are summarized per topic. See below first attempt to do so. Other remarks:a) We don’t really understand 108.1b) We are not sure why there is an FFS regarding support of adding SN terminated DRBs**Summary of previous agreements**General/ procedure1. Use of multiple candidates is support (108.3). FFS if same as for CHO2. If multiple candidates meet condition, selection is up to UE implementation (108.9)3. During execution, UE is not required to continue condition evaluation for other candidates4. No enhancements RA for multi-beam optimization5. It is possible to modify both condition and RRC configuration of a configured CPAC candidate (108.d)Condition related6. Condition is decided by MN and indicated by measId referring to MN configured measurement (107b.2)7. A4/ B1 like condition is supported (107b.3)8. Condition can comprise 2 conditions, with same RS type but different quantity9. Conditions are based on cell quality (108.7)10. TTT is supported (108.i)Signalling related11. Reconfiguration message can be used to configure one or more candidates, the RRC configuration of candidate target PSCell and the condition to execute CPAC for this candidate12. MN generates the Reconfiguration message including CPAC configuration, including a container for the RRC configuration of the CPAC candidate, that MN passes transparently13. We will use ToAddMod and ToRelease lists for CPAC candidatesOutstanding issues (FFS)1) FFS whether to support adding SN terminated DRBs2) FFS whether to use coordination for execution conditions |
| NEC | Applicable mostly | For #0 in RAN2#107bis “0 We will prioritize work in SN-initiated PSCell change for conditional PSCell change.”, we are fine with this, because the MN-initiated SN change (especially in (NG)EN-DC)) is mainly for inter-frequency mobility from source SN frequency to other frequency for e.g. load balancing. Mobility within source SN frequencies can be managed by the SN. For the former, we do not see strong need for CPC. However, we are also fine to discuss both MN-initiated and SN-initiated at the same time, if many companies want.For #6 in RAN#108, “6 SRB1 can be used in all cases. SRB3 may be used to transmit conditional PSCell change configuration to the UE for intra-SN change without MN involvement.”, agree with Nokia. |
| Spreadtrum | Applicable mostly | #0 is not necessary. |
| CATT | Majority of previous agreements can be applied | The following agreements can be applied for Rel-17 scenarios.RAN2#107bis agreements [1, 2, 3, 4, and 5]RAN2#108: first set of agreements applySecond set of agreements apply for PSCell addition. Stage 3 details could be left out for stage 3.Third set of agreements for CPAC configuration related proposals: agreements 2 and 3 apply. Agreement 5 and 6 are for intra-SN change without MN involvement, these are not relevant to Rel-17 scenarios. FFS point regarding the coordination of execution condition also apply and should be discussed for Rel-17 scenairos. FFS whether we need coordination on exact execution conditions or just measurements.FFS whether source or target SN knows the conditionFFS in which exact cases the condition needs to be indicated |
| Futurewei | Most are applicable  | Most the agreements above are applicable for R17. Some of the intra SN CPC specific requirements, as pointed by the companies, can be trimmed for further confirmation.  |

**2.2 Execution condition\ RRC message for CPA and MN initiated Inter-SN CPC**

The trigger condition for the conditional PSCell change is decided and provided by the SN in Rel-16 for intra-SN PSCell change. For Rel-17 scenarios, PSCell addition and MN initiated Inter-SN PSCell change, the MN should provide the trigger condition for CPAC execution to the UE [3, 4, 7,8]. And the trigger condition is defined by a measurement identity, given by a measurement configuration provided by the MN. As discuss in [4,9], for MN initiated inter-SN CPC and CPA, it’s up to the MN to decide the execution condition(s) and generate the final RRC message. Moreover as commented in [9], execution condition is only useful at UE side and does not help at the network side. Therefore, the node making decision of execution condition is aware of the execution condition, other nodes do not need to comprehend that information.

However in [11], it was proposed that an execution condition and configuration for a candidate PSCell is configured by the SN RRC message. According to this proposal, the MN transfers the execution condition to the candidate SN and the candidate SN generates the conditional configuration. The generated conditional reconfiguration message from the SN was sent to the UE transparently to the MN. The proposed procedure in [11] is significantly different from the convention PSCell addition procedure. As discussed in [16,17], conditional PSCell addition should take Rel-15 SN addition as baseline, e.g. reuse the existing signalling flows in 37.340 with minimal modifications.

In conclusion, the MN decides on CPAC execution condition for conditional PSCell addition and MN initiated Inter-SN CPC. The condition is defined by a measurement identity, given by a measurement configuration provided by the MN. This was agreed during Rel-16 discussion and further listed in question 1discussion for Rel-17 bulk agreements. For inter node communication of execution condition, it can consider that the MN is not required to indicate the execution condition(s) to other involved nodes (e.g. target SN, source SN) in MN initiated Inter-SN CPC and CPA.

**Question 2: Companies are requested to comment on below statement.**

**In MN initiated inter-SN CPC and CPA, the MN is not required to indicate the execution condition(s) to other involved entities (e.g. target SN, source SN).**

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| **Company** | **Agree/ disagree** | **Comments** |
| Nokia | In principle OK | Wherever possible, we should try to reuse the existing signaling and Rel-16 principles. On the other hand, there are already some means to indicate the likelihood of executing conditional reconfiguration to a particular node or cell (e.g. Estimated Arrival Probability, defined by RAN3 for CHO, to be used in HO REQUEST). Thus, if not the execution condition directly, some other metrics can be used between the nodes in order to alleviate the resource reservation burden. |
| Ericsson | Agree | True if the MN creates the final message to the UE. |
| MediaTek | Agree with comment | We agree that CPA should reuse the R15 SN addition procedure as much as possible. However, we have no strong view if NW vendors want to enhance the information sharing between MN and (source/target) SN. |
| Samsung | Agree as baseline | There was agreement that MN decides condition (107b.2) and we think this is baseline.R16 discussions resulted in an FFS on coordination for conditions. We assume this relates to the fact that that for non-conditional PSCell addition, it actually is the SN that decides the PSCell based on measurements provided by MN. |
| Intel | Depends | We should discuss overall design principles, rather than focusing on small aspects. As analyzed in our paper [11], there are two design principles:* **Option 1 (similar to Rel-16 PCell CHO):** an execution condition and configuration for a candidate PSCell is configured by the MN RRC message. For that, SN needs to provide, via the SN ADD REQ ACK message, (multiple) candidate PSCell configurations so that the MN can put together in its MN RRC message together with execution conditions.
* **Option 2 (similar to Rel-16 intra-SN CPC):** an execution condition and configuration for a candidate PSCell is configured by the SN RRC message. In Rel-16 intra-SN CPC, such RRC reconfiguration message from SN was sent to the UE transparently to the MN.

Our concern for Option 1 is mainly on signalling impacts. If we go with Option 1, SN should be able to send multiple PSCell configurations to the MN. And while doing that, the SN should tell the associated candidate PSCell info for each configuration, in order for the MN to generate the corresponding execution condition and put together into its final RRC message to the UE. This has to be supported via either SN ADD REQ ACK message or *CGConfig*, which requires significant changes either on RAN3 signalling or on RRC. And please note that it is very unlikely that RAN3 allows SN addition procedure parallelly to the same SN (one for each PSCell configuration). The reason why RAN3 decided to prepare CHO parallelly in Rel-16 was to abide by the existing HO REQ message which contains only one target cell ID. On the other hand, the conventional SN ADD REQ message already provides candidate cell info lists (via *CGConfig-Info*), for which SN decides one PSCell. There is no reason for MN to trigger SN addition procedure parallelly for CPA.Moreover, speaking of conventional PSCell addition, it has been designed in a way that SN provides a container for SCG cell group configuration to the MN (i.e. *CGConfig* > *scg-CellGroupConfig*), to be forwarded to the UE without requiring to be interpreted by MN. The Option 2 is indeed aligned with the conventional PSCell addition procedure. What we need to do for Option 2 (to abide by the past agreement that MN decides on execution conditions for CPA) is simply to enable MN to toss execution conditions for cells in candidate cell info lists via *CGConfig-Info* when sending SN ADD REQ message.  |
| NEC | Agree |  |
| Spreadtrum | Agree with comment | The involved target SN/source SN may need to know conditional PSCell change (not legacy PSCell change) even if it does not know the detailed execution conditions.  |
| CATT | Agree | We consider that the MN generates the conditional configuration message to the UE for CPA and MN initiated inter-SN CPC. |
| Futurewei | Agree | CPA is MN initiated. When MN determines the execution condition and configure it to the UE, we consider MN already took the input from the feedback of the candidate SN. There is no need to notify it to the candidate entities again. It is also not clear the benefits for doing so. |
| OPPO | Agree | Execution condition seems not useful for SN to determine proper target PSCells. It is measurements results which forwarded to SN from MN matters for determination of proper target PSCells. |

In Rel-16, the final RRC message carrying the CPC configuration is generated by the SN as the scenario considered is Intra-SN PSCell change without MN involvement. In Rel-17, the MN initiates CPA and MN-initiated Inter-SN CPC. In these scenarios, the conditional reconfiguration message should be generated by the MN [4,7,15]. The final conditional configuration message encapsulates the RRCReconfiguration provided by the candidate PSCell(s) and the conditional configuration message is provided to the UE in MN RRC format.

**Question 3: Companies are requested to comment on the below statement:**

**For conditional PSCell addition and MN initiated Inter-SN conditional PSCell Change, the MN generates and transmits the conditional configuration message (i.e. *RRCReconfiguration/RRCConnectionReconfiguration* message) to the UE, which the MN encapsulates the *RRCReconfiguration* provided by the candidate PSCell(s) as the *mrdc-SecondaryCellGroupConfig*/ *nr-SecondaryCellGroupConfig*. The MN is not allowed to alter the RRCReconfiguration provided by the candidate PSCell(s).**

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| **Company** | **Agree/ disagree** | **Comments** |
| Nokia | Agree | MN decides on the execution condition and compiles the final RRC Reconfiguration message. That is acceptable. |
| Ericsson | Agree |  |
| MediaTek | Agree |  |
| Samsung | Agree, except for encapsulation | Agree that MN generates the message towards UE. Statements regarding encapsulation seem incorrect. I.e. in case of MN initiated cases, we think the field conditionalReconfiguration in the MN generated message is used to signal the MN and SN generated parameters for a candidate. I.e. the SN generated message is carried within a subfield of the condReconfigToAddMod. |
| Intel | Disagree | Please see the above comment. I understand that the statement itself is written for the Option 1 above, but please note that it can be interpreted in align with the Option 2 as well... Better to re-word or clarify. |
| NEC | Agree |  |
| Spreadtrum | Agree |  |
| CATT | Agree |  |
| Futurewei | Agree |  |
| OPPO | Agree | It should be the target SN’s responsibility to determine the proper candidate PSCell (s) and corresponding RRC configuration based on the knowledge more than the measurement results, e.g., the load status of the cells. The related RRC configurations should be forwarded to the MN for generating the final msg in the case of CPA and MN initiated inter-SN CPC. |

**2.3 Execution condition\ RRC message for SN initiated Inter-SN CPC**

For SN initiated Inter-SN CPC, the SN should provide the CPAC trigger condition [3, 4,7]. Same as in Rel-16 CPC, the trigger condition in this case is defined by a measurement identity, given by a measurement configuration provided by the SN. This was agreed during Rel-16 discussion and further listed in discussion Question 1 for Rel-17 bulk agreements.

For SN initiated inter-SN conditional PSCell change, [15] discusses different options for generating the conditional configuration message. There are three main options:

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). The conditional configuration message is provided to the UE in MN RRC format.

Option 2: The target SN generates CPC. The source SN sets the execution condition and communicates it to the target SN. The target SN generates the conditional configuration message. The target SN generated conditional configuration message is provided to the MN (possibly in a transparent container) for transmission to the UE. The conditional configuration message in this option is provided to the UE in target-SN RRC format.

Option 3: The source SN generates CPC. The source SN sets the execution condition. The source SN communicates with target SN and receives RRCReconfiguration provided by the candidate PSCell(s). The source SN generates the conditional reconfiguration message and provides it to the MN (possibly in a transparent container) for transmission to the UE. The conditional configuration message is provided to the UE in the source SN RRC format.

The above options require inter-node communication for execution condition set by the source SN. Therefore, RAN3 input may also be required for the discussion. [15] proposes to wait for RAN3 inputs.

**Question 4: Companies are requested to comment on which option 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).**

**Option 2: The target SN generates CPC. The source SN sets the execution condition and communicates it to the target SN. The target SN generates the conditional configuration message. The target SN generated conditional configuration message is provided to the MN (possibly in a transparent container) for transmission to the UE.**

**Option 3: The source SN generates CPC. The source SN sets the execution condition. The source SN communicates with target SN and receives RRCReconfiguration provided by the candidate PSCell(s). The source SN generates the conditional reconfiguration message and provide it to the MN (possibly in a transparent container) for transmission to the UE**.

**Option 4: The source SN requests MN to perform SN change (the same legacy SN CHG REQD message) and the rest part follows the same as the MN-initiated inter-SN CPC in Option 2, for which the target-SN-generated CPC message is provided to the MN for transmission to the UE.**

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| **Company** | **Option** | **Comments** |
| Nokia | Option 1 or Option 3 (lower priority) | Option 1 is inline with CPA and MN-initiated inter-SN change, where MN compiles the message in the end, before sending to the UE. Option 3 can be considered, but it has an extra Xn impact (delay), compared to Option 1, if the communication between src and tgt SNs occurs via MN. |
| Ericsson | Option 1 |  |
| MediaTek | Option 1 |  |
| Samsung | Option 2 or 3 | We think we should not leave to RAN3 i.e. RAN2 should do a first selection of options, to ensure that from UE perspective the solution is consistent with existing conditional reconfigurations (see requirements below).Regarding the options we think that* We think the signaling on the radio should be same regardless of which solution is adopted (see essential characteristic 2 below)
* Option 3 seems cleanest, but it has quite some impact on RAN3 specifications (most significant changes)
* We think option 2 requires that T-SN inserts the configuration it generates within the S-SN generated message. We also need to discuss if, when T-SN cannot admit one of the candidates suggested by SN, whether the entire CPC will fail (or whether T-SN should remove the failed candidate from the S-SN generated message)

Essential solution characteristics (relevant from UE perspective):1. Network always generates a consistent message towards UE
2. MN will forward the final RRC(Connection)Reconfiguration message to the UE that includes the S-SN initiated message within *mrdc-SecondaryCellGroupConfig* (NR-DC) or nr-SecondaryCellGroupConfig ((NG)EN-DC). That 1st level embedded message includes field conditionalReconfiguration that a.o. includes the candidate’s RRC configuration as generated by T-SN (2nd level of embedding)

Other important characteristic (but more network internal)1. S-SN should be informed about the result of Conditional SN Change preparation/ configuration, regardless whether T-SN accepted or rejected

We note that MN may be a different RAT than SN and is not supposed to comprehend the SN generated information. As indicated above, T-SN generates condRRCReconfig, to be inserted within the S-SN generated message. We don’t understand how this can be done with option 1 (i.e. would eNB need to decode and re-encode concerned NR messages). |
| Intel | Option 4 | For SN-initiated case, we should consider, as baseline, that the decision to trigger the “legacy” or “conditional” SN change should be on the MN side, upon receiving SN CHG REQD message from the source SN. Then, we should further discuss whether there is a need for the source SN to specifically request MN to perform “conditional” SN change or not. |
| NEC | Option 3 (otherwise option 1) | As this is on SN-initiated, it would be better for the source SN to have a control like intra-SN CPC. So, option 2 is not preferable. We prefer either Option1 or 3. From RAN2 signaling point of view, we prefer the Option 3 which is similar to the framework of intra-SN CPC, because from UE point of view, it does not matter whether it is intra-SN or inter-SN basically. On the other hand, from X2/Xn signaling point of view, Option 1 may be simpler, as it will probably reuse the SN change procedure, although this is RAN3 scope. |
| Spreadtrum | Option 1 | Option 3 would need more Xn messages and introduce extra delay. |
| CATT | Option 1 | We prefer to design a solution in line with the CPA and MN initiated inter-SN. Also Option 1 results in less inter-node communication of execution condition.Also in legacy SN initiated SN change procedure, the MN communicates with the target SN. therefore we think Option 1 aligns with the legacy inter-node communication procedure as well. |
| Futurewei | Option 4 | Not clear the reason the execution condition is generated by the source SN in options 1-3. The source SN is lack of overall information of the neighboring SNs. It is more likely based on its own condition to request an inter SN CPC. After the MN received the request from the source SN, it should conduct the same procedure as for MN initiated CPA. This approach is more efficient since MN has the global information than the source SN. It is also simpler since we don’t need to have a completely separated procedure for SN initiated case.  |
| OPPO | Option 2 or Option 3 are prefered | Regarding the option 1, we share the similar concern with Sumsung that MN needs to comprehend the execution condition and conditional Reconfiguration provided by source SN and target SN respectively, which might not be feasible for inter-RAT cases. Otherwise, signaling impact on Xn interface is foreseen.For both Option 2 and Option 3, the MN’s job is only to forward the RRCReconfiguration in container to UE since the RRCReconfiguration msg is encoded in source/target SN RRC format |

SN initiated Inter-SN CPC requires inter-node communication for execution condition set by the source SN whichever the option selected in question 4. It should be further discussed whether the MN or target SN needs to know the execution condition(s) decided by the source SN or not, i.e. whether the execution condition(s) is encapsulated into a container to the MN/ target SN or not.

Moreover as commented in [9], execution condition is only useful at the UE side and it may not help at the network side. Therefore, other nodes do not need to comprehend that information.

**Question 5: In SN initiated CPC with MN involvement, the source SN transfers the execution condition(s) to the MN or to the target SN (depending on selected option in question 4). Should the MN or the target SN need to comprehend the execution condition set by the source SN?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Comprehend or not** | **Comments** |
| Nokia | In general NO | The need for MN-SN comprehension should be minimized, especially in inter-RAT cases. The answer depends on the details of the signaling between source SN and MN regarding the CPC execution. |
| Ericsson | Yes | How can the MN make the configuration otherwise? |
| MediaTek | No strong view |  |
| Samsung | No/ agree as baseline | MN may concern a different RAT and should hence not be required to comprehend the SN generated informationThis somewhat relates to the issue discussed in question 2 i.e. about negotiation for conditions. |
| Intel | No | As commented above, for SN-initiated case, we think that MN should decide whether to trigger the legacy or “conditional” SN change.  |
| NEC | No | as baseline, but can be revisit after further progress. |
| Spreadtrum | Yes | MN needs to generate the conditional reconfiguration message including the execution condition(s) provided by the source SN and RRCReconfiguration provided by the candidate PSCell(s). MN needs to link the conditional reconfiguration message to the corresponding execution condition(s). |
| CATT | No | We think the execution condition should not be comprehended by the MN or the target SN. This follows the principle of MN doesn’t need to comprehend the information generated by the SN. Stage 3 signaling design should be discussed. |
| Futurewei | No | Agree with Intel. |
| OPPO | Target SN should comprehend | One major target for the MN or the target SN to comprehend the execution condition set by the source SN is to leave them a possibility to modify the execution condition. In our opinion, target SN might know the load status of the candidate PSCell(s) better and therefore might have enough reason to tune the execution condition to let the UE be prone to change to the PSCell with lower load status. |

**2.4 Use of SRBs**

As discussed in [17], there are some differences in different CPAC scenarios, with regards to the use of SRB1 or SRB3 to transmit CPAC configurations to UE. SRB1 can be used in all CPAC scenarios, while SRB3 can only be used in the CPAC scenarios where MN is not involved. For CPA, only SRB1 can be used for CPA configuration transmission. For Inter-SN CPC (both SN initiated and MN initiated), the MN is involved with communication to the target SN. Therefore only SRB1 can be used for CPA and Inter-SN CPC.

In Rel-16, the complete message upon CPC execution is sent via SRB1 to the MN if the CPC configuration is transmitted using SRB1. Following Rel-16 principle, the complete message upon CPAC execution for CPA and Inter-SN CPC in Rel-17 should be provided to the MN via SRB1.

**Question 6: Companies are requested to comment on the below statement:**

**Only SRB1 can be used in CPA and Inter-SN CPC scenarios in Rel-17. The complete message upon CPAC execution for CPA and Inter-SN CPC in Rel-17 should be provided to the MN via SRB1.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/ disagree** | **Comments** |
| Nokia | Agree, but… | However, to some extent it depends which option is chosen in Q4 for inter-SN CPC. If option 1 then we do agree. If Option 3 then other signaling possibilities maybe also considered. |
| Ericsson | Agree | Agree for option 1. Could be good to limit the cases. |
| MediaTek | Agree |  |
| Samsung | Agree |  |
| Intel | Agree | Agree, regardless of options in Q4. |
| NEC | Agree |  |
| Spreadtrum | Agree |  |
| CATT | Agree |  |
| Futurewei | Agree |  |
| OPPO | Agree | Due to the potential absent of SRB3 after CPAC, SRB1 should be used to transmit the complete msg. |

**2.5 Feedback message/ compliance check**

If SRB1 is used for the transmission, it’s up to the MN to generate the final RRC message including the conditional reconfiguration container. [4,5] discuss that upon reception of RRCReconfiguration/RRCConnectionReconfiguration message with CPAC configuration, the UE shall check the received MN RRC reconfiguration message and execution condition(s) included in the message, but not need to check the RRC reconfiguration message included in the container. Thus, the UE shall just reply the RRCReconfigurationComplete/RRCConnectionReconfigurationComplete message to the MN to inform that the message has been received, not including an embedded RRC complete message to the SN. The same principle was used in Rel-16 CPC.

**Question 7: Companies are requested to comments on the below statement:**

**If SRB1 is used for the transmission of CPAC configuration, upon reception of RRCReconfiguration/RRCConnectionReconfiguration message with CPAC configuration, the UE shall reply the RRCReconfigurationComplete/RRCConnectionReconfigurationComplete message to the MN to inform that the message has been received. The message shall not include an embedded RRC complete message to the SN.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/ disagree** | **Comments** |
| Nokia | Agree | Yes, it is just a confirmation of the reception of conditional reconfiguration. Not the confirmation of the execution. It follows the Rel-16 principle.  |
| Ericsson | Depends | If the SN created the message with the execution conditions, there needs to be a reply back to the SN. It depends on which node that created the message, that node needs to get the Complete message. |
| MediaTek | Agree |  |
| Samsung | Agree |  |
| Intel | Depends | Agree with Ericsson. |
| NEC | Agree  | as the proponent of [5] |
| Spreadtrum | Agree |  |
| CATT | Agree | Same as Rel16 principle |
| Futurewei | Agree | This is only to acknowledge the UE successfully received the CPAC reconfiguration message. We think in all the cases, the execution condition should be determined in MN. Not see a link of this UE ack-message with SN. |
| OPPO | Agree | Follow principle used in R16 CPC |

Similar to Rel-16 principle, it is beneficial to check the validity of the different contents in the conditional PSCell addition/change RRC Reconfiguration message received over MN SRB1 at different times to not increase the RRC Reconfiguration processing delays.[16] proposes to reuse this principle for Rel-17 CPAC scenarios.

**Question 8. Companies are requested to comment on the below statements:**

* **UE checks the validity of conditional PSCell change execution criteria configuration immediately on receiving the CAPAC Reconfiguration message.**
* **Compliance check for embedded RRCReconfiguration may be delayed until execution (up to UE implementation). Introduce no specification changes regarding compliance checking of embedded Reconfiguration message containing configuration of conditional PSCell candidate.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/ disagree** | **Comments** |
| Nokia | Agree | We can follow the Rel-16 principle here. |
| Ericsson | Agree |  |
| MediaTek | Agree |  |
| Samsung | Agree |  |
| Intel | Agree |  |
| NEC | Agree |  |
| Spreadtrum | Agree |  |
| CATT | Agree |  |
| Futurewei | Disagree the second point. | We will accept majority companies’ decision. Just to point out if the validation is conducted at the CPAC execution it will cause the UE waste power to continue measure the invalid candidates after CPAC is configured. When an execution is triggered for an invalid candidate, it will cause a failure for CPAC and eliminate the chance of the UE to continue to evaluate and access to a valid candidate. |
| OPPO | Agree |  |

In Rel-16 CPC, when the condition is met, the UE sends the RRCReconfigurationComplete for SN embedded in the ULInformationTransferMRDC to the MN (when SRB1 is used). In Rel-16, only the Intra-SN without involving MN scenario was considered. In Rel-17, CPA and Inter-SN CPC, the MN may involve with the CPA/CPC configuration. Therefore, [5] proposes to further discuss the use of ULInformationTransferMRDC for the transmission of RRCReconfigurationComplete message upon the CPAC execution.

Upon execution of CPAC, since the UE may apply the configuration generated by the MN and the configuration generated by the SN simultaneously, the UE needs to provide the RRC complete message to both the MN and the (target) SN [5]. Thus, the UE shall reply the RRCReconfigurationComplete/RRCConnectionReconfigurationComplete message to the MN including an embedded RRC complete message to the SN, and then the MN informs the SN.

**Question 9: If SRB1 is used for the transmission, in CPA and Inter-SN CPC, upon execution of CPAC, the UE shall reply the RRCReconfigurationComplete/RRCConnectionReconfigurationComplete message to the MN including an embedded RRC complete message to the SN, and then the MN informs the target SN.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/ disagree** | **Comments** |
| Nokia | Agree, follows Rel-16 principle. | But this assumes that the CPC conditional reconfiguration is received from the MN (as stated in the beginning of Q9’s text). |
| Ericsson | Depends | Agree if it is the MN that created the message that is applied when the conditions are fulfilled. It depends on which node that generated the message that is applied upon execution. If the SN built that reconfiguration message, the complete message needs to be sent in ULInformationTransfer to the MN first and then forwarded, as there is no RRCReconfiguration from the MN which the UE can reply to.  |
| MediaTek | TBD | We would like to understand more on what should be include in the MN RRC complete message. If it only include the embedded SN complete message, how could MN aware that which target gNB is selected by the UE?  |
| Samsung | Somewhat agree | We think ULInformationTransferMRDC should be used to transfer the complete message (as for intra-SN CPC) |
| Intel | Depends | Agree with Ericsson |
| NEC | Agree as proponent | for clarification, this is only if the MCG configuration is/can be changed upon triggering the CPA and/or inter-SN CPC.  |
| Spreadtrum | Agree |  |
| CATT | Agree | We would like to follow Rel-16 principle. We are opened to discuss whether to use ULInformationTransferMRDC or not. |
| Futurewei | Agree | We think upon the execution is triggered, the UE knows which target cell is. The target ID can be indicated in the complete message to MN. The UE sends the complete message to the MN. Then MN should forward the embedded SN complete message to the target SN.  |
| OPPO | Depends  | We agree with Ericsson  |

**2.6 Events for execution condition**

 [7, 8, 17] discuss the events should be used as execution condition for CPA and Inter-SN CPC. Event A3 and A5 use for configuration of conditional PSCell change condition. For conditional PSCell addition, event A4 (neighbour becomes better than threshold) is required to set PSCell addition condition in NR-DC and event B1(inter RAT neighbour becomes better than threshold) is required to support conditional PSCell addition in MR-DC (EN-DC or NGEN-DC). In conclusion, [7, 8, 17] propose that A3/A5 execution condition should be supported for conditional PSCell Change including new scenarios while A4/B1 based execution condition should be supported for CPA. This was agreed during Rel-16 discussion and further listed in question 1 for Rel-17 bulk agreements.

**Question 10: Companies are requested to comment on whether any additional event (in addition to A3/A5 for CPC and A4/B1 for CPA) should be considered for execution condition in CPA and Inter-SN CPC.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/ disagree** | **Comments** |
| Nokia |  | These events are needed and shall be adopted. However, we are not sure yet if this list is exhaustive and the rules how to use those events are fully known and identified. Thus, we would be eager not to close that topic yet. |
| Ericsson | Agree |  |
| MediaTek | FFS | Agree to follow R16 agreement, where event A3/A5 is used for CPC and event A4/B1 is used for CPA. Additional event could be discussed based on the need. |
| Intel | Agree |  |
| NEC |  | at this moment, this can be as baseline, while later we can discuss as commented by Nokia. |
| Spreadtrum |  | New event can be introduced if necessary. |
| CATT |  | A3/A5 for CPC and A4/B1 for CPA are sufficient. No additional events are required. |
| Futurewei |  | We don’t see additional events are needed. |
| OPPO | Agree | At this stage no, but we are ok to leave this as FFS and see if any need to be emerged later. |

**2.7 Release of CPA/CPC configuration**

For CPC, it was agreed to release the CPC configuration upon the completion of PSCell change in Rel-16 scenario: Intra-SN PSCell change. The same is applicable for Inter-SN CPC in Rel-17. For conditional SN addition, the MN configures the candidate SN cells. After completion of conditional SN addition, the candidate cell configuration provided by the MN for SN addition is no longer useful considering that single SN is active at a time. As discussed in [7], the configuration provided by the MN for conditional SN addition cannot be used for conditional SN change. Therefore, it is logical for the UE to release the conditional SN addition configuration upon the successful SN addition.

**Question 11: Companies are requested to comment on the below statement:**

**Baseline that the configurations of all candidates PSCell configurations for CPA and Inter-SN PSCell change are released upon the successful completion of CPAC, conventional PSCell change or conventional PSCell addition.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/ disagree** | **Comments** |
| Nokia | Agree | This is a good baseline for Rel-17.  |
| Ericsson | Agree |  |
| MediaTek | Agree |  |
| Samsung | Agree |  |
| Intel | Agree |  |
| NEC | Agree |  |
| Spreadtrum | Agree |  |
| CATT | Agree |  |
| Futurewei | Agree |  |
| OPPO | Agree  |  |

**2.8 CPAC failure handling**

In Rel-16 CPC, SCGFailureInformation procedure is used to inform the MN of conditional PSCell change failure. Additional scenarios to be introduced in Rel-17 are conditional PSCell addition and inter-SN PSCell change. As discuss in [7], the Rel-17 scenarios do not impose different requirements for failure handling procedure when compared to that of Rel-16 CPC scenario. Therefore, following Rel-16 procedure, SCGFailureInformation procedure can be taken as baseline for CPAC failure handling in Rel-17 scenarios.

**Question 12: Companies are requested to comment on the below statement.**

**Following Rel-16 procedure, SCGFailureInformation procedure can be taken as baseline for CPAC failure handling in Rel-17 scenarios.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/ disagree** | **Comments** |
| Nokia | Disagree | We are OK to use this message, but its content needs to be properly discussed and designed. In Rel-16 there were no new CPC-related parameters defined due to the lack of time within the WI. However, this topic shall be properly addressed in Rel-17, involving new CPC scenarios and CPA. The exact details could be postponed and addressed when Stage-3 discussion occurs.  |
| Ericsson | Agree |  |
| MediaTek | Agree |  |
| Samsung | Agree |  |
| Intel | Agree |  |
| NEC | Agree | as baseline  |
| Spreadtrum | Agree |  |
| CATT | Agree |  |
| Futurewei | Disagree | We have similar view as Nokia. We think the failure procedure should be further discussed in R17 considering the difference of CPAC from the conventional SCG failure monitoring/reporting procedure.  |
| OPPO | Agree | It is fine to take it as baseline. Any enhancement required could be further discussed in this release. |

**2.9 Any other aspect**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Not sure if these could be classified as the topic for easy agreements, but we would like to discuss also the CPA/CPC and CHO coexistence, which has been down-prioritized in Rel-16, while it seems to be a significant topic to many companies (based on RAN2#111 TDocs).  |
| Spreadtrum | Since both MN and SN can configure CPC for UE, it is necessary to promise that the total number of CPC is not larger than the maximum CPC number (R16, 8; R17 FFS). |

# 5 Conclusion

[To be completed]

# 6 Reference

[1] R2-2006695 Scope and scenario for CPAC vivo discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[2] R2-2006757 Coexistence of CHO and CPC at the UE InterDigital discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[3] R2-2006805 Discussion on conditional PSCell change and addition OPPO discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[4] R2-2006901 Discussion on conditional PSCell addition/change ZTE Corporation, Sanechips discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[5] R2-2006976 Overview of conditional PSCell addition NEC discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[6] R2-2006977 Inter-SN Conditional PSCell Change NEC discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[7] R2-2007010 Scope and basic procedure for Conditional PSCell Addition/Change ??(CPAC)? CATT discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[8] R2-2007052 Discussion on conditional PSCell addition or change Spreadtrum Communications discussion

[9] R2-2007089 Discussion on conditional PSCell change and addition Apple discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[10] R2-2007130 Scenarios and General Principles of CPAC ETRI discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[11] R2-2007237 Rel-17 Conditional PSCell Addition Intel Corporation discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[12] R2-2007364 On the scope of Rel-17 CPAC Nokia, Nokia Shanghai Bell discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[13] R2-2007439 Consideration on dormant SCG CMCC discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[14] R2-2007553 Inter node CPAC procedure and configuration discussion Futurewei discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[15] R2-2007599 Conditional reconfigurations Ericsson discussion LTE\_NR\_DC\_enh2-Core

[16] R2-2007624 Further enhancements on conditional configuration for R17 Samsung Telecommunications discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[17] R2-2007679 Discussion on Conditional PSCell addition/change Huawei, HiSilicon discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[18] R2-2007749 Conditional PSCell addition/change Qualcomm Incorporated discussion Rel-17

[19] R2-2007839 Conditional PSCell addition and change in MR-DC Potevio discussion LTE\_NR\_DC\_enh2-Core

[20] R2-2007985 Considerations of CPAC in Rel-17 LG Electronics discussion Rel-17

[21] R2-2008079 Remaining issues of Conditional PSCell Addition NTT DOCOMO INC. discussion Rel-17 LTE\_NR\_DC\_enh2-Core Late