3GPP TSG-RAN WG2 Meeting #110 R2-200xxxx

Elbonia, Online, 1 – 12 June 2020

**Agenda item: 6.9.x**

**Source: Nokia, Nokia Shanghai Bell**

**Title: Report from [AT110-e][209][LTE/NR MOB] CHO and CPC issues (Nokia)**

**WID/SID: LTE\_feMob-Core/NR\_Mob\_enh-Core - Release 16**

**Document for: Discussion and Decision**

# 1 Brief scope of the paper

This document aims at collecting companies’ views regarding the open issues for Conditional Handover (CHO) and Conditional PSCell Change (CPC), in line with the following guidance:

* [AT110-e][209][MOB] CHO and CPC issues (Nokia)

Scope:

* + - Discuss the contributions [R2-2005344](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005344.zip), [R2-2005682](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005682.zip), [R2-2005681](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005681.zip), [R2-2005380](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005380.zip), [R2-2005456](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005456.zip) in AI 6.9.2 and the contributions [R2-2005345](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005345.zip), [R2-2005381](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005381.zip), [R2-2005279](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005279.zip) in AI 6.9.3
    - Determine what (if anything) can be agreed based on the handled contributions

      Intended outcome:

* + - Discussion summary in [R2-2005754](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005754.zip) (by email rapporteur).

      Deadline for providing comments and for rapporteur inputs:

* + - Deadline for companies' feedback:  Friday 2020-06-05 10:00 UTC
    - Deadline for rapporteur's summary (in [R2-2005754](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005754.zip)):  Monday 2020-06-08 16:00 UTC

# 2 Open issues for CHO

## 2.1 On when to stop evaluating the execution conditions

The authors of [1] and [4][5] re-discuss the topic that has been considered at RAN2-109bis, namely the UE’s actions regarding when to stop the evaluation of execution conditions. In [1] it is proposed to change the CHO-related text in TS 38.300 and say the evaluation is stopped when ‘handover is triggered’, not when ‘the execution condition is met’, as currently captured. The authors of [4] modify the same part of the text by adding ’or HO command is received’. It is worth checking whether companies see a need for introducing such change(s) in Stage 2 specification.

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| **Question 1: Do you see a need for changing the text in 9.2.3.4.1 of TS 38.300, in line with that is proposed in [1] or [4]?** | | |
| **Company** | **YES/NO** | **Motivation** |
| Ericsson | No | In our view this is not important and meeting time should not be spent on it. The only intuitive way to solve this is to stop CHO upon CHO execution and/or HO execution. |
| OPPO | Yes | We are ok with the change from [4]. |
| NEC | Yes | To complete the issue, can change to include the case of receiving legacy HO command. Either way is fine but suggest using the same way for CPC case discussed in Q4. |
| CATT | Yes | The current spec only cover the CHO case upon the execution condition is met, however it is equivalent for the legacy HO execution, the legacy case should also be captured in the spec, so the proposal in [1] or [4] can be accepted. |
| Futurewei | Yes to principle, but | No need the proposed change, simply require not initiate CHO execution when a HO execution is on-going. It is following general principle that an on-going execution should not be interrupted by initiating another execution. Now it is addressed case by case, in Rel 17 it is better to have generic approach to review all parallel activity cases to make sure there is no holes. Stopping CHO evaluation is just one of the UE implementations to avoid a new CHO execution during an on-going execution. We can just impose a requirement to stop a new execution when there is an on-going execution. How to do that can be left to UE implementation. |
| Huawei, HiSilicon | Yes |  |
| Lenovo | Yes | We agree to change for covering both HO execution and CHO execution.  ‘HO command’ is related with HO and CHO. In the current 38.300, ‘HO command (without CHO configuration)’ is used to indicate legacy HO command. Therefore, the change from [4] is not reasonable.  We propose:  stops evaluating the execution condition(s) once handover is executed. |
| Intel | Yes | The changes from [1] is ok. |
| Google | Yes | Changes from [1] is sufficient. |
| Interdigital | Yes | We prefer the change proposed in [4] as it clearly indicates the two cases. |
| Qualcomm |  | The change in [4] of adding legacy HO is fine. No need to change existing the CHO part. |

## 2.2 CHO and fast MCG recovery

The authors of [2] consider another topic which was deemed complete after RAN2-109bis. The co-existence of fast MCG recovery and CHO. It is proposed to introduce an explicit indication from the NW which recovery mechanism the UE shall use in case both fast MCG recovery and CHO recovery were configured while the UE encounters an RLF. In addition, it is proposed to agree the UE can still use CHO in cell reselection happening after failed MCG recovery (Proposal 2 in [2]). It seems the topic was concluded at RAN2-109bis and companies believed no new aspects of this coexistence need to be covered in the standard in Rel-16. However, if that is not the case, please express your view and motivation why the topic shall be reopened.

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| **Question 2: Do you see a need to still specify something with respect to fast MCG recovery and CHO coexistence in Rel-16? E.g. the indication from the NW which recovery mechanism the UE shall use in case both fast MCG recovery and CHO recovery is configured while the UE encounters an RLF [2]?** | | |
| **Company** | **YES/NO** | **Motivation** |
| Ericsson | No | The only reason we have not agreed to forbid this corner case was because the impact in the spec would be minimal. If that is re-open we would propose to rather add a restriction to disable this dual configuration. |
| OPPO | No | Current spec already implies that UE will perform fast MCG recovery in this case. |
| NEC | No | when the MCG failure is detected and the UE is configured with fast recovery, the UE shall trigger fast MCG recovery. |
| CATT | No | The configuration of t316 and the CHO configuration are both configured via dedicated signalling. The NW can avoid configuring both T316 and CHO for the UE. Even though both the T316 and CHO are configured for the UE, the current spec has specified the procedure which mechanism should be performed upon the RLF occurred, which can work well, so no need to introduce extra indication and extra specification. |
| Futurewei | Yes but | Network configuration is an option to eliminate the ambiguity. Another simpler alternative is to specify fast MCG recovery have higher priority since SCG connection is more certain and reliable than CHO candidates. If MCG recovery is failed, go into reestablishment procedure and CHO candidates can be involved. If CHO execution has been triggered, ignore MCG failure and continue the CHO execution, and follow the CHO reestablishment procedure if CHO is failed. |
| Huawei, HiSilicon | Yes | Since fast MCG recovery and CHO can be coexisted, the NW has the right to indicate the UE behaviour when RLF happen, thus UE behaviour can be controlled. |
| Lenovo | No | We have already agreed in last meeting that UE is only allowed to perform fast MCG link recovery and stopping evaluating CHO condition upon RLF on MCG. We don’t see the reason to re-open it. |
| Intel | No | It has been discussed several times. We should not reopen the discussion on this. |
| Google | No | We don’t see a problem in the current specification. |
| Interdigital | No | We are ok to stick to agreement made last meeting. |
| Qualcomm | No |  |

## 2.3 CHO in MR-DC operation

The authors of [3] discuss the coexistence of CHO and MR-DC operation. RAN2 has already agreed that ‘*’CHO (MCG) can work together with MR-DC, i.e. receive CHO when MR-DC is configured, and receive SCG addition when CHO condition is configured.*’’ RAN2 has also agreed ‘’*...not to preclude SCG configuration in RRC Reconfiguration with conditional reconfiguration. Limit to cases without RAN3 impact*.’’. In [3] it is further claimed that a solution in Rel-16 is needed to decrease unreliability and signalling overhead due to the possibility to include SCG config in RRC Reconfiguration with CHO. As a result, it is proposed to release the SN upon CHO execution., which would be always done based on the indication in the target cell’s configuration. In addition, [3] proposes that the UE even informs the SN that it is about to be released by the UE. Companies are asked to express their opinion whether such changes are need in Rel-16.

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| **Question 3: Do you agree the SN shall be released by the UE upon CHO execution? Shall the UE inform the SN prior to such release, as suggested in [3]?** | | |
| **Company** | **YES/NO** | **Motivation** |
| Ericsson | No | We see no need to change the previous agreements. Network behaviour would take care of the release if needed. We see no reason to add restrictions. We made very clear we did not see the need for further RAN3 work, but we should not set their agenda in RAN3.  Is the goodbye message back again? Interesting. We wonder why can’t we do as in legacy. |
| OPPO |  | We are not sure if RAN2 can conclude this without involving RAN3. |
| NEC | No | unless RAN2 receives some negative feedback for the LS from RAN3, we do not see any need to re-discuss the issue. |
| CATT | No | Release of SN, can be left to the NW implementation, i.e. the target MN can update the CHO configuration based on the update of the SN, the UE just applied the target candidate cell configuration.  The use of inter-node message requires RAN3 involvement. Therefore we think NW implementation based can be used in Rel-16.  Disagree with informing the SN of the release, UE doesn’t inform MN upon execution of CHO, so we can’t accept the informing the SN upon the execution of CHO either. |
| Futurewei | No | If MN is not notified by earlier by “bye” message, there would be no need to worry about SN only. |
| Huawei, HiSilicon | No | Same as legacy handover in MR-DC, whether to release the SN can be indicated by the network. |
| Lenovo | No | We can discuss it if we receive LS from RAN3. |
| Intel | No | Based on the procedure indicated in [3], it is target MN triggered SN release. Then if the target MN does not want to have SN, it should not include SCG in CHO configuration and can simply release it. We assume it can resolved as legacy, and it is RAN3 scope. We should only change if RAN3 ask us to do so. |
| Google | No | The network should take care of the SN release for the UE. |
| Interdigital | No | If we stick to the current agreements, the NW can handle the release and there is no need to inform the SN either. |
| Qualcomm | No |  |

# 3 Open issues for CPC

## 3.1 CPC evaluation and CPC config in PSCell Change command

Some of the remaining open issues for CPC are discussed in [6]. First identified gap is whether the UE shall stop evaluating CPC execution conditions once a PSCell change is triggered (i.e. not once the execution condition is met). This proposal in [6] is closely associated to what has been proposed in [1] for CHO.

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| **Question 4: Do you agree with the changes proposed in [5], to modify the TS 37.340 by stating the UE stops evaluating the execution conditions once ‘PSCell change is triggered’, instead of once ‘the execution condition is met’?** | | |
| **Company** | **YES/NO** | **Motivation** |
| OPPO | No | We proposed to add something like “ or PSCell change command is received”. |
| NEC |  | No strong view. An alternative way may be to change to “once the execution condition is met or legacy PSCell change is triggered”.  We suggest using the same way as CHO case discussed in Q1. |
| CATT | Yes, but | Similar with question 1, the UE should stop the evaluation of the execution condition upon the execution condition is met and the legacy PSCell change is triggered. Similar with question 1, one of the following change can be adopted, but the modification should be align with the modification on CHO, i.e. question 1.  Option 1: modify the evaluation is stopped when ‘PSCell change is triggered’  Option 2: adding ’or PSCell change command is received’ |
| Futurewei | Yes to principle, but | No need the proposed text change, simply require not to initiate CPC execution during a PSCell change execution. How to stop initiating CPC execution can be left to UE implementation. |
| Huawei, HiSilicon | No | “PScell change is triggered” is unclear to us, e.g. it may be “UE handling the legacy PScell change command” or “CPC is executed”. |
| Lenovo | Yes, but | We agree to change for covering both CPC and legacy PSCell change. We propose e.g. UE stops evaluating the execution conditions once CPC is executed. |
| Intel | Yes | Ok to align with CHO. |
| Google | Yes |  |
| Interdigital | No | Similar to our response in Q1, we prefer adding “or PSCell change command is received”. |
| Qualcomm |  | A similar sentence to CHO in Q1 is fine, e.g. suggested by Interdigital or NEC |

Another topic tackled in [6] is whether a CPC configuration can be allowed in the legacy PSCell change command. The authors of [6] propose to make it forbidden and insert a corresponding change into the field description of *conditionalReconfiguration*. What is RAN2 view on that?

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| **Question 5: Can CPC configuration be provided in legacy PSCell change command? Do you agree with the change in [6] to capture the associated behaviour in the field description?** | | |
| **Company** | **YES/NO** | **Motivation** |
| OPPO | Yes |  |
| NEC | Yes | agree with the proposal, i.e. not to allow the CPC configuration in legacy PSCell change command. The proposed change to the field description is also fine. |
| CATT | Agree | Similar with CHO, it is not allowed to configure the CHO in the legacy HO command, the CPC should also not be allowed to configure in legacy PSCell change command. Agree with the proposals in [6]. |
| Futurewei | Yes. | Should not be considered in Rel-16. |
| Huawei, HiSilicon | No to the first question. No strong view on the second one. | CPC configuration provided in legacy PSCell change command seems no much benefits and may cause complicated UE behaviour, e.g. legacy PSCell change command fails and CPC configuration needs to be dropped out by the UE. So we do not prefer to allow the CPC configuration in legacy PSCell change command. |
| Lenovo | Yes | CPC is not allowed to be included in legacy PSCell change command in Rel-16. |
| Intel | Ok with proposal in [6] | Seems companies replied Yes, is to agree the proposal in [1], i.e. not include CPC in legacy PSCell change command.  We also agree the proposal. |
| Google | Yes | We have a different view from the other companies. We don’t see such restriction is needed. The network should be allowed to include the CPC configuration in the legacy PSCell change command. |
| Interdigital | Ok with the proposal in [6] | We should be consistent with what was agreed for CHO in the legacy HO command, and not allow CPC configuration in legacy PSCell change. |
| Qualcomm | Yes | The argument for not doing this in CHO was that when legacy HO target gNB configures a CHO at a different target gNB, there may be security issues (although it is still not clear why there would be a problem). Since Rel-16 CPC is for intra-gNB, that argument is invalid. |

## 3.2 On CPC configurations upon PCell change

The authors of [7] elaborate on security aspects after Pcell change if the UE was also prepared with CPC. One can assume that when Pcell changes then CPC configurations are not valid, as the key for SN is derived from MN’s key (which might have changed during Pcell change). The authors of [7] suggest to leave it up to the NW whether to release the CPC configurations in case of Pcell change if the same *sk-counter* is used. This is a broader topic of what the UE should do with CPC configurations during Pcell change.

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| **Question 6: Should the NW be allowed to configure whether the UE releases the CPC configurations upon Pcell change (e.g. when security key does not change)?** | | |
| **Company** | **YES/NO** | **Motivation** |
| OPPO | No | We should follow the same way as CHO, i.e. releasing CHO after successful Pcell HO. |
| NEC | Yes? | Q6, which is slightly different from the proposal in [7], is a bit confusing.. E.g. is “configure whether the UE releases …” to mean “configure to release..”? probably, so. Then, our understanding is as follows.  The scenario in question is only the intra-MN HO (Pcell change) without SN change (even without PSCell change) in NR-DC. Otherwise, security key (either KgNB and/or S-KgNB) must be changed, or stored CPC config is not valid due to PSCell change (regardless of S-KgNB change).  Then in the corresponding scenario, it can be up to network (SN) to release the CPC configuration when necessary e.g. due to security key change. |
| CATT | Yes | Considering the MN may not aware of the CPC configuration , and the SN may also not aware of the Pcell change when the Pcell change without SN involved, in order to avoid introducing a new inter-node message, the release of CPC can leave to the SN. Upon the SN is involved when the Pcell change, the SN can release the CPC via explicit signalling, if the SN is not involved upon the Pcell change, the CPC can be kept and still be vaild. |
| Futurewei |  | No strong opinion. Doing this could save some ignalling overhead. It is cleaner if simply reset old CPC configurations. |
| Huawei, HiSilicon | Yes | We don’t think CPC configuration is necessarily invalid after Pcell change (especially for intra-SN CPC). It should be up to the network to decide how to handle the security issues. UE just derive the security keys based on the received NCC and *sk-counter,* if any. |
| Intel | No | If the UE does not autonomously remove the CPC configuration upon successful PCell change, we have to discuss whether the evaluation of CPC shall be stopped or not in order to avoid the potential security problem. The simple way is just follow CHO, i.e. release CPC upon successful PCell change. |
| Google | Yes | The network can always take care of the CPC configuration in this scenario. We should avoid that the UE autonomously releases the CPC configuration. |
| Interdigital | Yes | There is no need for the UE to autonomously release CPC configuration if the PCell change at least for the case where it does not involve a key change. The NW can indicate whether release is needed or not. |
| Qualcomm |  | The release should be left to the NW implementation and not rely on UE autonomous release. |

## 3.3 CPC completion to SN when SRB3 is used

The authors of [8] discuss the topic which has been partially concluded at RAN2-109bis, i.e. whether there is any complete message sent to the MN once the UE executes CPC which was configured via SRB3. The authors of [8] propose to send this notification to SN, instead of MN which is claimed to reduce the transition latency and also get network prepared for the CPC failure handling. Do companies see a need for such functionality?

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| **Question 7: In case of SRB3, should the UE send a CPC complete message to the source PSCell (SN) upon CPC execution?** | | |
| **Company** | **YES/NO** | **Motivation** |
| OPPO | No | We have concluded not to have any bye-message. |
| NEC | No | We do not see valid argument in [8].  When SRB3 is used, the UE sends the CPC complete to target PSCell and that is sufficient. Any other thing or enhancement seems not needed. |
| CATT | No | Upon the CPC execution, the UE will send the CPC complete message to the target PSCell if the CPC is configured via SRB3. In this release only intra-SN PSCell change is considered for CPC, hence the source PSCell and target PSCell belong to the same gNB. The UE doesn’t need to send the CPC complete message to the source PSCell upon CPC execution. |
| Futurewei | Yes | By doing this, CPC operation latency can be reduced without any cost. It supported by the following observations:   1. In legacy DC operations such as SN addition, the UE sends RRCReconfigurationComplete to MN upon the execution started rather than waiting for completion of access to SN. We should follow the same principle. 2. After execution is triggered, CPC completion on the target is almost certain since the failure rate is very low. Early notifying the CPC completion to the network (via SN) will allow network to early prepare the target PSCell and MN for all the CPC successful cases. 3. There is also no negative impact to the CPC failure case since anyway SCG will be reset after a CPC failure. MN could get prepared earlier for this.   In a separate discussion, [8] suggests to modify the stage 2 text when SRB1 is used to reflect that CPC complete message is sent to MN upon the start of CPC execution. This approach will get the same benefit as above discussed for SRB3 configured case. In our understanding, this stage 2 modification will be aligned with current stage 3 text and the RAN2 agreement:  If SRB3 is not configured, the UE first informs the MN that the message has been received. Then the UE needs to provide the CPC complete message to the SN via the MN upon CPC execution. |
| Huawei, HiSilicon | No strong view | It seems some benefits via this approach. But the question is, upon CPC execution, the souce PScell quality may be too low/weak. In this case the CPC complete message to the source Pscell UE may not be transmitted successfully. |
| Lenovo | No | Agree with CATT. |
| Intel | Yes | For CHO, we agreed, the UE sends complete message to ACK the RRC reconfiguration message from source, and the complete message to ACK the HO command generated from target node, i.e. two RRC complete message. The main motivation is to follow existing RRC modelling. In addition, the RRC configuration message from source may also contain the source configuration, so anyway the ack is needed.  For CPC, same principle should be applied. |
| Google | No | Agree with CATT. |
| Interdigital | No | Only complete message to the target PSCell is needed. Similar to discussion about bye message in CHO, a complete message to the source PSCell may not be reliable. |
| Qualcomm | No | Agree with CATT. This also should not be done even for inter-gNB CPC in the future. |

# 4 Conclusions

Based on the views expressed in the previous sections, we propose the following:

# 5 List of referenced documents

[1] [R2-2005344](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005344.zip) *On stopping evaluating execution condition once triggering the legacy HO*, ZTE

[2] [R2-2005380](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005380.zip) *Discussion on leftovers for CHO*, Huawei, HiSilicon

[3] [R2-2005456](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005456.zip) *Further consideration on CHO in MR-DC operation*, CMCC

[4] [R2-2005681](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005681.zip) *Stage 2 CR for CHO evaluation handling during legacy HO*, LG Electronics

[5] [R2-2005682](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005682.zip) *CHO evaluation handling during legacy HO*, LG Electronics

[6] [R2-2005345](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005345.zip) *Remaining issues for CPC*, ZTE

[7] [R2-2005381](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005381.zip) *Discussion on leftovers for CPC*, Huawei, HiSilicon

[8] [R2-2005279](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2005279.zip) *Corrections on procedure for CPC complete*, Futurewei