**3GPP TSG-RAN WG2 Meeting #109 electronic R2-200xxxx**

**Elbonia, 24 Feb – 6 Mar 2020**

**Agenda item: 6.9.3.6**

**Source: Intel Corporation**

**Title: Report of [AT109e][212][MOB] CHO configuration and execution details (Intel)**

**Document for: Discussion and Decision**

# Introduction

This is the email discussion report on below email discussion:

* [AT109e][212][MOB] CHO configuration and execution details (Intel)

Scope:

* + - Agreeing on the proposals as per [R2-2002040](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2002040.zip).
    - Discuss open items as per [R2-2002040](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2002040.zip) to seek companies feedback on open issues of CP for CHO.

Intended outcome:

* + - Proposals with consensus that can be incorporated (if needed) in the running CR(s) (aim to agree to those over email)
    - List of remaining open issues that need to be pursued in next meeting (if any).
    - Issues that should no longer be pursued

Deadline for providing comments and for rappporteur inputs:

* + - Companies input: Thursday, Feb. 27th 3:00 CET
    - Rapporteur proposals: Friday, Feb. 28th 12:00 CET
    - Comments on proposals: Monday March 2nd by 17:00 CET

# Discussion

### 2.1 Agreements proposed to be agreed in this meeting (from all sub-topics)

As proposed in [38], below proposal is considered as easy agreement.

**Proposal S4\_1::**The UE shall autonomously remove measObject(s) only associated to CHO upon suspend/release, CHO/HO execution and re-establishment;

**Question 1: Do companies agree the proposal S4\_1 listed above? If no, pls indicate your reason.**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| MediaTek | Yes | Not sure if network configures measObjects in this way, but if yes, measObject(s) only associated to CHO upon suspend/release, CHO/HO execution and re-establishment |
| ZTE | Yes |  |
| OPPO | Yes |  |
| Futurewei | Yes | The measObject only linked to the reportConfig for the CHO is released. |
| Huawei, HiSilicon | Yes |  |
| Intel | Yes |  |
| Sharp | Yes |  |
| CATT | Yes | Upon release, the UE will release the measConfig autonomously, so the UE will also remove the measobject associated to CHO. Any further enhancement can be discussed in a future release. |
| Lenovo&MM |  | We agreed that ‘It is up to UE implementation whether the measurement on other candidate cell shall be continued during CHO execution period’. That means that UE may autonomously perform measurement, which could be helpful for cell selection if CHO/HO fail. Therefore, the UE may not remove measObject(s) only associated to CHO upon CHO/HO execution.  In addition, we agreed that ‘measID and reportConfig associated with CHO config shall be removed when CHO configuration is autonomously removed.’ So, the proposal can be changed to ‘measObject(s) only associated to CHO shall be removed when CHO configuration is autonomously removed. |
| Samsung | No | There is no need to add UE complexity, also noting that it seems highly likely the same MO will be used again for RRM or CHO after CHO execution |
| Nokia |  | In general, it is safer to remove just the measID (which is unique and not used for other measurements), MeasObjects should be deconfigured by the NW in all cases other than failure scenarios. |

### 2.2 Open items proposed to be further discussed in this meeting (from all sub-topics)

**DISC S1\_1:**For “and” condition, further discussion on which option should be selected, Option A, B, C, D or E.

Option A: event 1 still satisfy entry condition after its TTT expires when event 2 TTT expires.

* This option has the most companies support during email discussion. However, there are no contribution submission in this meeting.

Option B: consider event satisfies entry condition during TTT as fulfilled and consider event not satisfies entry condition during TTT as not fulfilled. Only both events fulfilled starts CHO.

* This option is in the email discussion and have some support. However, there are no contribution submission in this meeting.

Option C: Similar to Option B, but “not fulfilled” is determined based on leaving condition instead of entry condition; [1] [7];

* Supporting companies: Ericsson, Intel

Option D: based on single TTT. “Not fulfilled” similar to C. The second event satisfy entry condition to start single TTT [5]

* Supporting company: futureWei
* This is also same as original Ericsson proposal in the email discussion

Option E [20]: CHO is executed when both events fulfil its entry condition for corresponding TTTs preceding the time of triggering CHO execution.

* Samsung

**Question 2: For “and” condition, which option should be selected, Option A, B, C, D or E.?**

|  |  |  |
| --- | --- | --- |
| **Company** | **A, B, C, D, E?** | **Remark** |
| MediaTek | E | When two events are configured, CHO can be triggered only if both events are triggered, i.e. each entry condition is satisfied for corresponding TTT preceding the time of triggering CHO execution. Even if cond1 was satisfied for TTT1, UE leaves event1 immediately when cond1 is not satisfied.  To make configuration simpler, we can have a single TTT. |
| ZTE | C | Considering more that two triggering conditions may be allowed to configure for a single candidate cell in later releases, we prefer to define fulfill condition for each event to avoid the complexity and ambiguity of text description. And the measurement report like mechanism can be reused for the definition of fulfill condition. |
| OPPO | A | For CHO execution, we think the condition that matters most should be the entering condition. Option A means that the earlier fulfilling event has a larger TTT than its configured one. |
| Futurewei | D | An event is holding after its entering condition has been fulfilled and leaving condition is not met.  The AND execution triggering condition is fulfilled if the first event has been entered and holds till the entering of the second event and both two events are holding over a TTT\_joint.  The starting point of the TTT\_joint is the moment that the second event entering condition is fulfilled.  The TTT2 configured for the second event is used as the TTT\_joint of the two event AND triggering.  Comments: Only use entering condition is not enough, leaving condition have to be included. Two events each with their TTT can not be AND together since two TTTs have different durations and the events entering time is different. Only one TTT is needed and started upon entering the second event. |
| Huawei, HiSilicon | C |  |
| Intel | C | We would prefer to reuse existing solution as much as possible. TO our understanding, for Option C, the checking on whether cho trigger event is still met or not based on Leaving condition that was used in measurement report. . |
| CATT | A or E | Option D will introduce restriction on the configuration of TTT, option C is based on the leaving condition which is not algin with the initial intention, comparing with option B, option A and option E is straightforward. |
| Lenovo&MM | A | The intention of introducing TTT is to improve the reliability and reduce HO failure. The expiry of both TTTs for two events should be considered in the CHO. |
| Samsung | E | The simplest one while sufficient and necessary for the required operation. |
| Nokia | A | In 108#66 there was a significant support for this option and this is the most intuitive way of combining two events, as each can have its own TTT and TTT may be started at different time (as the event entry criteria will be satisfied at different time instances) + each need to be fulfilled at least for the duration of TTT. We think either option A is adopted or ‘AND’ shall not be considered for linking CHO execution triggering events. |

**DISC S1\_2:**Further discussion on whether different measurement object in A3+A5 combination is supported or not.

**Issue 2: [1] raised for A3/A5 combination, whether original agreements “same RS type” for multiple trigger events is still valid or not, in addition whether different measurement Object is allowed.**

* Is different RS type in A3+A5 combination supported?
* Is different measurement object in A3+A5 combination supported?

Contribution [1] indicated that whether different measurement objects are allowed to be configured with CHO has not been discussed before. For same/different RS type, RAN2 have spent lots of time on this. It would be good not revise agreement unless it is necessary. It would be good to only have further discussion on measObject.

**Question 3: Should different measurement object be supported or not in A3+A5 combination?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| MediaTek | No | We should stick to the agreement of “the same RS type”, and a reasonable interpretation is that UE should also evaluate the two events based on the same measObject. |
| ZTE | No | Considering the limited time, we prefer not to revise the agreement of “the same RS type” and correspondingly only allow to configure two execution conditions based on the same measObject. |
| OPPO | No | We don’t see the need of different measurement objects. |
| Futurewei | NO | Two events already pretty complicated. The benefit may not worth the efforts. |
| Huawei, HiSilicon | No |  |
| Intel | No | Agree others’s view indicated above. |
| Sharp | No | Two events based on the same measObject is sufficient for most mobility scenario. |
| CATT | No | There is no needed to support different measurement object, the measurement monitoring is performed on the appointed cell i.e. the PCI in the reconfigurationWithSync, so there is no need to support different measurement object for one appointed cell measurement monitoring. |
| Lenovo&MM | No | We don’t see the benefit to introduce the different RS. |
| Samsung | No | We don’t see any motivation to this. So don’t want to discuss. |
| Nokia | No | Just to clarify, we consider triggering conditions for a single CHO candidate cell? In such case, it is enough to rely on a single MO. |

**DISC S2\_1:**To discuss whether the UE shall stop the evaluating the execution condition during legacy HO/CHO. Or the UE shall not apply CHO configuration when a new execution condition is met during HO/CHO;

**CHO execution condition is not fulfilled when T304 is running:**

* Supporting companies: **LG**

|  |
| --- |
| In contribution [32], According to the previous agreement, the network can send the HO command after sending CHO configuration. However, in our view, there is a leak point in the stage-3 running CR in that the CHO can be triggered while performing the HO [3].  The reason why the UE faces a situation that the CHO execution condition is met while performing the HO is due to the time difference between receiving the HO command and detaching the source cell. Because of the time difference, the UE can monitor candidate cells until the source cell configuration is replaced by the target cell configuration.  Then, according to the current Running CR, the CHO monitoring procedure leads to the CHO execution procedure regardless of whether the HO is performed.  To avoid unexpected UE behavior, we propose to mandate UE behaivor in this case. There may be various ways to mandate UE behavior, but we think the most proper and simple way is to mandate the UE not to perform CHO while performing HO. It can be achieved by specifying the UE to perform CHO only when the T304 is not running. |

The relevant agreements are:

*Agreement 1: 3 If UE receives conventional handover command, it will execute the handover command regardless of stored (configured) conditional handover command. This applies if the HO cmd is received before any CHO triggering condition is satisfied.*

*Agreement 2“UE is not required to continue evaluating the triggering condition of other candidate cell(s) during CHO execution”.*

So far, agreement 2 is UE implementation, i.e. the UE may still continue the evaluating the execution condition when T304 is running (i.e. during legacy HO or CHO). To address the issue raised by LG:

**Option 1**: change agreement 2 to ““UE shall stop evaluating the triggering condition of other candidate cell(s) during CHO/HO execution”..

* We still need to capture it in the specification.

**If not:**

**Option 2** [32]: the UE shall not apply CHO configuration when a new execution condition is met during HO/CHO.

Ask RAN2 to discuss whether the UE shall stop the evaluating the execution condition during legacy HO/CHO. Or the UE shall not apply CHO configuration when a new execution condition is met during HO/CHO. .

**Question 4: Shall the UE stop the evaluating the execution condition during legacy HO/CHO,i.e. option 1? Or shall the UE not apply CHO configuration when a new execution condition is met during HO/CHO, i.e. option 2?**

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| --- | --- | --- |
| **Company** | **Option 1 or 2?** | **Remark** |
| MediaTek | Option 2 | We think current Agreement 2 is fine. We also agree that   * When there are multiple CHO candidates, UE can choose the candidate * UE executes legcy HO when receiving legacy HO command, even if CHO configured.   Thus, evaluating another candidate cell (when this is still possible) does not mean the UE will terminates HO/CHO execution if the conditions are met for that cell. This is most likely for failure handling, i.e., if HO/CHO fails, UE can peform CHO to the candidate.  However, if companies have concern about unexpected behaviour, we can have some clarification as in Option 2. |
| ZTE | Option 1 | We prefer the UE stops evaluating the triggering condition of other candidate cell(s) during CHO/HO execution. Even if the execution of CHO fails, the UE shall trigger the CHO based failure handling if allowed, which is based on the cell selection, rather than the evaluation result of other candidate cells. |
| OPPO | Option 1 | During legacy HO/CHO execution, UE has released the source cell and thus shall not evaluate any execution condition configured in the source cell. |
| Futurewei | Option 2 | Agree with MediaTek. In order to minimize the delay for failure handling, it should be allowed that UE implementation may perform the measurement and evaluation of other candidates as long as the currently on-going execution is not interrupted. |
| Huawei, HiSilicon | Option 2 | Share the same view as MediaTek. |
| Intel | Option 2 | Current agreement is“*UE is not required to continue evaluating the triggering condition of other candidate cell(s) during CHO execution*”. It is also leave the freedom to the UE, i.e. the UE may or may not perform the evaluation. The only thing we need to do is, avoid the UE to perform execution condition when T304 is running. |
| Sharp | Option 1 | Agree with ZTE’s view. |
| CATT | Option 2 | We think the UE check T304 before executing HO. If the T304 is running, the UE shall not apply CHO configuration when a new execution is met. |
| Lenovo&MM | Option 2 | Agree with MTK. Don’t need to stop evaluation, which can be used for the potential HO/CHO failure handling. |
| Samsung |  | It is enough to say that UE does not trigger CHO during HO/CHO. It is not good to overspecify the other details. The rest is upto UE implementation. |
| Nokia | Option 1 | Not sure what this discussion is actually about? Option 1 is written in a strict manner (with ‘shall not’), but – as Intel described – actually the UE can be free to do whatever the UE wants (including monitoring other candidates). What only matter is that the UE cannot apply a new CHO configuration/candidate cell when it is already executing CHO. We thought this is already obvious, as we decided UE can try once and then recover via cell selection and possibly CHO… |

**DISC S3\_2:** to discuss whether the cho-ExecutionCond is also OPTIONAL, Need S?

**Yes [1] Ericsson**

The issue was not discussed in the email discussion 108#66. It would be good to confirm in RAN2.

**Question 5: Shall the cho-ExecutionCond also be OPTIONAL, Need S?**

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| **Company** | **Yes/No** | **Remark** |
| MediaTek | Yes |  |
| ZTE | Yes | It’s beneficial for signalling overhead reduction when the NW just wants to modify the CHO configuration included in the cho-RRCReconfig but not for the CHO execution condition. |
| OPPO | Yes |  |
| Futurewei | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Intel | No | cho-ExecutionCond at most contains two measIDs, totoal 12 bits. Do we really need to support delta signalling on this? |
| Sharp | Yes |  |
| CATT | Yes | the NW may only update the configuration of the candidate cell without update the execution condition. |
| Lenovo&MM | Yes |  |
| Samsung | NO | Q5 seems against convention i.e. within CellGroupConfig spCellConfig is just need M (while also this field is mandatory to signal at setup).  We would also be fine to not have delta signaling in particular for the condition i.e. seems just a minor optimization. We would also be fine to have both mandatory, which would be even simpler (change of condition seems infrequent so no problem to signal target config once more) |
| Nokia | Yes | Agree with ZTE. |

**DISC S3\_3:** should we allow CHO configuration without cho-ExecutionCond?

The issue is raised in [3]. Company wants to have CHO candidate cell only for failure handling instead of normal CHO.

* Supporting company: vivo

**Question 6: should we allow CHO configuration without cho-ExecutionCond?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| MediaTek | No | We agreed that CHO candidate can be access when HO/CHO fails, even if execution conditions are not met. This implies that the network may configure a strict execution condition (e.g., A3 with a large offset) for CHO, but the candidate cell is indeed usable even if the conditions are not met, so we agree to use it as a kind of failure handling. But this doesn’t mean that the network should configure a CHO candidate which is intentionally for failure handling case. It is “irresponsible” for a network to configure a CHO candidate without giving corresponding execution conditions. |
| ZTE | No | Share the same view with MediaTek. |
| OPPO | No | We also think CHO configuration is intentionally done for normal CHO execution and failure handling via CHO is just an add-on feature. We should allow CHO configuration without cho-ExecutionCond. |
| Futurewei | No | If doing so, it defeats the purpose. A configured CHO candidate should be prepared for CHO at first… Network implementation can prepare some close neighbors for possible reestablishment to minimize delay and avoid context fetch. But it is a separate topic. We don’t need to mix reestablishment enhancement with CHO configuration. |
| Huawei, HiSilicon | No |  |
| Intel | No |  |
| Sharp | No | Share the same view with MediaTek. The main purpose for CHO is for actual handover not for failure recovery. |
| CATT | No | No need to introduce extra impact on current running CR, the current configuration supports the failure handling. |
| Lenovo&MM | No | The main target of CHO is to improve the HO reliability rather than failure hanldling. |
| Samsung | no | Please refere the answer of Q5. |
| Nokia | No | Definitely not. CHO configuration + execution condition is not primarily meant for recovery, but for CHO execution, where condition is mandatory. |

**DISC S5\_1:** to discuss whether 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;

Two cases are raised in contribution [2]:

* Case 1) UE operating in MR-DC receives a CHO configuration (from MN, so this is not about PSCell change, but about handover);
* Case 2) UE monitoring CHO conditions is configured to start operating in MR-DC (e.g. SCG addition).
* Supporting company: Ericsson

The question is whether these two cases are allowed or not. **If yes, to avoid RAN3 impact, the UE shall autonomously release MR-DC upon execution of CHO.** It would be good to discuss this in the meeting.

**Question 7: Can CHO (MCG) work together with MR-DC, i.e. receive CHO when MR-DC is configured, and receive SCG addition WHEN CHO condition is configured;?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| MediaTek | Yes |  |
| ZTE | Yes |  |
| OPPO | Yes | For simplicity, the target of CHO should only be MCG and no SCG is involved. |
| Futurewei | Not this release | Since the time of CHO execution is not certain. Autonomously release MR-DC may introduce surprise to network MR-DC operations. We need more time to evaluate and cannot make decision for this release. Can be discussed in future release. |
| Huawei, HiSilicon | Yes |  |
| Intel | No | It is questionable whether the network will establish the link between SCG and candidate MCGs. If not, the SCG shall be released upon successful CHO. But how to release SCG? Seems more considerations are needed to support it. |
| Sharp | Yes | No need to restrict. And it is fine that UE releases MR-DC upon CHO execution to avoid much impact. |
| CATT | Yes | We don’t see the need to restrict DC when CHO is configured. The two features have two different purposes. |
| Lenovo&MM | Yes | It is not complicated to support two cases if ‘release MR-DC upon execution of CHO’. |
| Samsung | Yes | Seems not really essential for R16, but anyhow see no need for specification changes i.e. signaling allows and can leave this up to network implementation |
| Nokia | Yes |  |

**DISC S5\_2:**To discuss whether CHO (MCG) configuration can contain SCG configuration or not; If yes, we need to clarify only Pcell can be candidate cell.

**Question 8: Can CHO (MCG) configuration contain SCG configuration or not?; If yes, do you agree that we need to clarify only Pcell can be candidate cell?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| MediaTek | Yes | It’s good to clarify only Pcell can be candidate cell |
| ZTE | Yes | It’s good to clarify only Pcell can be candidate cell |
| OPPO | No | We prefer to keep it simple and do not involve DC as target configuration of CHO. |
| Futurewei | NO | Maybe considered in next release. |
| Huawei, HiSilicon | Yes | It’s good to clarify only Pcell can be candidate cell |
| Intel | No | It is questionable whether/how to establish the connection between candidate MCG and candidate SCG, it also needs RAN3 evaluation whether it can be supported in RAN3. Therefore, we prefer to make it simple in Rel-16. |
| Sharp | Yes | It’s good to clarify only Pcell can be candidate cell |
| CATT | yes |  |
| Lenovo&&MM | Yes | It should clarify only Pcell can be candidate cell. |
| Samsung | Yes | Please refer the above answer in Q7. |
| Nokia | Yes | Agree with MTK and ZTE. |

### 2.3 Rel-16 Mob can work without these optimization, and proposed not be treated in this meeting

In [38], some issues are considered as non-essential issues, and suggested not treated in this meeting. But it would be good to take this chance to check companies’ view since anyway we have email discussion on open issues.

**Optimization S16\_1:**Discuss whether signalling optimization on legacy HO command is needed or not based on the solution if the network wants to trigger a conventional handover to one of the configured CHO candidate cells, one target cell indication (e.g. candidate cell index) can be included in the conventional HO command to trigger the ~~CHO execution~~normal handover of the indicated candidate cell. **[13][20]**

* **Supporting companies: ZTE, Saumsung:**

**Question 9: Is the solution described above needed? i.e. if the network wants to trigger a conventional handover to one of the configured CHO candidate cells, a target cell indication (e.g. candidate cell index) can be included in the conventional HO command to trigger the normal handover of the indicated candidate cell.?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| MediaTek | No | In most CHO execution conditions are similar to the conditions for legacy HO. Configuring CHO is to allow UE to execute HO at better tining. We don’t see the need of such signalling optimization. |
| ZTE | Yes | The NW may want to trigger a conventional HO to one of the configured CHO candidate cells due to overload control. Considering the signaling overhead of conventional HO command is large and the UE may fail to receive a big RRC message from the NW when the source quality deteriorates dramatically, we see some benefits to just indicate the candidate cell index in the HO command to trigger the normal HO of the indicated candidate cell. |
| OPPO | Yes | We have some sympathy with this proposal and think it can save signalling overhead. |
| Futurewei | No | CHO candidate configuration maybe already out of date when the new HO is requested by the network especially in the case new HO is needed. |
| Huawei, HiSilicon | No | We do not want to couple the configurations of legacy HO and CHO too much, because it may bring extra complexity. In addition, if we agree on it, we may need more time on details and potential impacts to RAN2.  We think it is an optimization but not critical issues for CHO, so we suggest to discuss it in later releases. |
| Intel | No | We assume, anyway the source has to communicate with target again to trigger the convential HO. And then the target will provide the HO command again. It is not nice to let the source to check whether the configuration in HO command is exact same as the configuration in CHO or not unless we ask the target node to add additional indication that will have RAN3 impact. In addition, we are not so sure how likely the configuration could be same for CHO and convential HO. |
| Sharp | No | We share MediaTek’s view. |
| CATT | No | this optimization will introduce impact on the current running CR e.g. which signalling will be used |
| Lenovo&MM | No | For this case, source can reconfigure the condition. |
| Samsung | Yes | We think this is not just signalling optimization but also increasing HO reliability by reducing the HO command size drastically. And already in failure case UE autonomously uses the given CHO configuration. So there is no need to block the usage of normal cases.  Regarding   * Futurewei comment: we design CHO configuration is up-to-date based on the source cell configuration. If there is any need to update the source, network should ensure also update the Cho target config too. This fresh target configuration is already coming for free by CHO. * Intel comment: there is no need to check the configuration of target since already CHO target configuration is ready to be used at anytime. That is the principle of CHO now. * MTK comment: there is no restriction of legacy HO command. If network wants it can command at any time. And there is up-to-date configuration to be used.   Huawei comment: reducing the size of HO command is used as the ground for signalling design in DAPS DRB configuration issues. We think eMOB WI level requirement (i.e., increasing reliability of HO) can be achieved by reducing HO command size, not only signalling optimization in CHO area. For further effort on RAN2, it is very intuitive and simple as in our Tdoc TP. RRCReconfiguration msg can include cho config index. |
| Nokia | No | We see some merit in such approach, but think it is a bit too late in Rel-16 to consider it. |

**Optimization S16\_2:**Discuss whether CHO execution condition is defined based on the existing measID+additional a3-Offset or a5-Threshold in CHO-ExecutionCond, i.e. we do not need to introduce cho-trigger event in reportConfig.

**to reduce the overhead on measurement configuration, the network can configure the existing measID with additional a3-Offset or a5-Threshold as the CHO execution condition in the RRCReconfiguration/RRCConnectionReconfiguration message, for instance:[14]**

* **Supporting company: ZTE**

CHO-ExecutionCond-r16 ::= SEQUENCE {

measID MeasID,

a3-Offset MeasTriggerQuantityOffset, OPTIONAL, -- Need R

a5-Threshold1 MeasTriggerQuantity, OPTIONAL, -- Need R

a5-Threshold2 MeasTriggerQuantity, OPTIONAL, -- Need R

...

}

-- TAG-CHO-CONFIGTOADDMODLIST-STOP

-- ASN1STOP

**Question 10: Is the solution described above needed? that is CHO execution condition is defined based on the existing measID+additional a3-Offset or a5-Threshold in CHO-ExecutionCond, i.e. we do not need to introduce cho-trigger event in reportConfig?**

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| **Company** | **Yes/No** | **Remark** |
| MediaTek | Yes | Can be adopted if such signalling optimization does not cause other troubles. |
| ZTE | Yes | Generally, the CHO execution condition is similar with the conventional HO condition except the threshold/offset is set a little bit higher than baseline (i.e. the conventional handover). So we can consider to reuse the existing measID configured for other RRM purpose with additional a3-Offset or a5-Threshold as CHO execution condition. In this way, no CHO specific reportConfig and new measID are required. Given that at most 8 candidate cells (if agreed) and corresponding at most 16 execution conditions may be configured for the UE, reusing the existing measID with additional a3-Offset or a5-Threshold can greatly reduce the signaling overhead. |
| OPPO | No | This will make existing ASN.1 less readable. |
| Futurewei | Yes | It is a simple approach. |
| Huawei, HiSilicon | Yes |  |
| Intel | No | The only difference between extending reportCOnfig or add offset in measID is where the threshold is put. But to have the whole picture on execution condition, the network still needs to configure reportConfig, i.e. with this new approach, the network needs to configure threshold in CHO-ExecutionCond and other parameters in reportConfig.  From signalling overhead perspective, there is no big difference since anyway the reportConfig is needed to indicate other configurations.  We still prefer the way in the running CR, i.e. put all trigger related configuration in the reportConfig, that is clearer to us. |
| Sharp | Yes | We also think the CHO execution condition is similar with the conventional HO condition except the threshold/offset, such optimization is reasonable. But if we go this way i.e. using existing measID, we need to ensure the measID used here should not be autonomously released by UE at e.g. successful handover, RRC reestablishment cases, if this existing measID is used for other RRM purpose. |
| CATT | No | This will reduce the overhead of the measConfig, but will increase the execution condition configuration overhead. |
| Lenovo&MM | No | According to the discussion, we assume measID for CHO is cho specific. For example, measID will be removed if cho config is removed. If we support this, some agreement need to be revisited. |
| Samsung | No | We have some sympathy (main benefit of re-use seems to be that CHO evaluation would not result in additional measurement ID to count for RRM performance requirements), but anyhow prefer to defer |
| Nokia | No | We have discussed how to describe CHO execution condition in ASN.1 for a couple of meetings already. Thus, we are not eager to consider such changes now. |

**Optimization S16\_3:**Discuss whether multiple CHO execution condition (using or) of a single candidate cell is allowed.

**Allow configuring multiple CHO execution conditions (using “or”) of a single candidate cell. [14][5]**

* **Supporting company: ZTE, FW:**

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| --- |
| ***[14] Although the current signaling structure allows to configure multiple CHO candidates with the same CHO container but different execution conditions (i.e. actually triggering CHO execution of the same candidate cell under different execution conditions), the redundant CHO container configuration shall largely increase signaling overhead. Thus, we think it’s better to allow configuring multiple triggering conditions (using “or”) linked with a single candidate cell (i.e. a single CHO container). Besides, based on proposal 1, it’s easy to configure multiple execution conditions for a single candidate cell by just configuring different threshold/offset values with the same measID.*** |

**Question 11: Is the network allowed to configuring multiple CHO execution conditions (using “or”) of a single candidate cell?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| MediaTek | Yes | We think this makes sense. However, the configuration may be complicated if we want to allow both “and” and “or” configurations. |
| ZTE | Yes | We see some benefits to allow the NW to configure multiple CHO execution conditions using “or”. An indicator can be introduced to indicate the relationship between multiple triggering conditions (i.e. either “and” or “or”). |
| OPPO | No | We wonder whether multiple conditions are realistic. |
| Futurewei | Yes | “Or” operation is also explained and supported in Futurewei contribution [5] |
| Huawei, HiSilicon | Yes |  |
| Intel | No | DO not see the need to configure 2 executino condition “or” for the UE. If to support it, we also need to discuss whether the execution condition still contains two or one cho trigger event, and whether the maximum number of the execution condition is still one? |
| Sharp | No |  |
| CATT | No | if the NW want make the CHO execution is relaxed, the NW can only configure one execution condition |
| Lenovo&MM | No | Multiple conditions can be flexible. What is use case to introduce multiple conditions? |
| Samsung | No | Can be discussed in the future release. |
| Nokia | No | This was already discussed in 108#66. We do not see any use for that. When multiple execution conditions were discussed in one of the RAN2 meetings, companies clearly said they see a use case when those conditions are linked with “AND”. We think multiple conditions are not needed in general, but if supported, ‘AND’ should be the only relationship between them. |

**Optimization S16\_4:**Discuss whether introduce measurements results (including beam level results) in HO complete message.

**measurement results (including beam leavel) in HO complete message. [23]**

* **Ericsson**

|  |
| --- |
| ***[23] One way to mitigate that could be to include measurements in an RRCReconfigurationComplete transmitted from the UE to the target upon CHO execution, so the target has a chance to immediately re-configure the UE’s e.g. by adding and/or removing and/or activating/deactivating SCell(s).*** |

**Question 12: Is it needed to contain the measurement results (including beam level results) in HO complete message?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| MediaTek | No | Target cell knows which beam is the best for UE from random access procedure. Other re-configurations can be done later. If CHO complete message can carry measurement results, can legacy HO also do this? |
| ZTE | No | Upon the execution of CHO, the UE shall apply the target measurement configuration. The measurement results based on the source configuration may be not valid for the target cell. |
| OPPO | No | This is not a CHO-specific issue and legacy HO works well without this. |
| Futurewei | No | The benefit of doing this is still not very clear. It is also not clear if the source cell configured measurement results is useful for the target. Wouldn’t the L1 report is required at the target for BM? |
| Huawei, HiSilicon | No |  |
| Intel | No |  |
| Sharp | No |  |
| CATT | No | this seems to be a eDCCA problem, not belong to the topic of mobility |
| Lenovo&MM | No | It is not CHO specific issue. |
| Samsung | No | Can be discussed in the future release. |
| Nokia | No | Agree with MTK and OPPO. CHO alone is not a justification for introducing such measurement results in Complete message. Like others asked, why there is no such reporting for legacy HO? |

**Optimization S16\_5:**Discuss whether an RRCReject is allowed in response to an RRCReconfigurationComplete upon CHO execution.

**Reject CHO for load reason or race condition [23]**

* **Supporting company: Ericsson**

|  |
| --- |
| ***[23] The main purpose of that was to minimize signalling in overload situations where the target decides to release its allocate resources for CHO. It is indeed possible that a target candidate accepts an incoming UE for CHO and after some time decides not to accept. It may also happen that while the target tries to cancel a CHO, the UE fulfils an execution condition and tries to access that same target.***  ***Observation 1 Upon CHO execution, UE may try to access target that is trying to cancel the procedure e.g. due to overload.***  ***One simple solution for that could be if the target simply responds an RRCReconfigurationComplete upon CHO execution with an RRCReject.*** |

**Question 13: Upon CHO execution, Is it allowed that the network sends RRCReject message in resonse to an RRCReconfigurationComplete message?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| MediaTek | No | This is an optimization for a rare case. If we introduce this for CHO, we should also allow RRCReject for legacy HO? |
| ZTE | No | The NW can’t indicate a UE in RRC\_CONNECTED state into RRC \_IDLE state by using RRCReject message since the message is not protected by the security key. If needed, the NW can send a RRCRelease message to release the UE into RRC\_IDLE state. |
| OPPO | Yes | We think this has some benefit in case where target already releases the configuration, but UE has not received the release signaling. |
| Futurewei | No | Normally HO rejection should be happened at the preparation phase. HO access is never blocked due to overload. Network also normally does not select an overloaded cell as the target (candidates in CHO). |
| Huawei, HiSilicon | No |  |
| Intel | No | Same question as MediaTek. |
| Sharp | No | We do not think this optimization is needed, can rely on RRC release message in overload case as legacy. |
| CATT | No | if the target still has the UE context, the target cell can send the RRCRelease when the UE complete the HO, if the target cell has deleted the UE context, the NW can reject to respond with MSG2 to let the RACH procedure fail. |
| Lenovo&MM | Yes | Race condition could happen. |
| Samsung | No | Can be discussed in the future release. |
| Nokia | No | As pointed out by Sharp and ZTE, in case of overload, the NW can send RRC Release soon after the UE completes CHO. |

**Optimization S16\_6:**Discuss whether add serving radio link status information in measurement report.

**extending the measurement report with serving radio link status information [28]**

* **Supporting company: Nokia**

|  |
| --- |
| ***[28]*** To mitigate the risk described in the preceding subsection, measurement reports may contain more information to help the serving node in taking the appropriate decision. In the simplest form, the indication could say whether T310 or T312 has been initiated for this serving link. Such knowledge is currently not available to the NW together with the MR, whereas it could seriously impact the final decision whether it is still acceptable and safe to configure the CHO, or the quality of the link is already so bad that the immediate HO shall be commanded. |

**Question 14: Is it needed to add serving radio link status information in measurement report?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| MediaTek | Yes | This may be helpful. |
| ZTE | No | Different measurement reports (e.g. different thresholds) can be configured to trigger CHO preparation and legacy HO. The NW can decide the right mobility triggering decision based on the measurement results (e.g. the RSRP/RSRQ value). |
| OPPO | No | No sure about the value of doing so since measurement report anyway includes serving cell measurement results. |
| Futurewei | Yes | Helpful for network to know radio link status. |
| Huawei, HiSilicon | No | Not clear on the benefits. |
| Intel | No | This is not CHO specific issue, should be discussed in general for measurement. |
| Sharp | No | The benefit of introducing serving radio link status is not convinced. Current measurement reports works well. |
| CATT | No |  |
| Lenovo&MM | No | Serving cell measurement result is sufficient for souce cell to decide. |
| Samsung | No | Can be discussed in the future release. |
| Nokia | Yes | Well, this is a CHO-specific thing, as before Rel-16 the NW did not have a choice whether to trigger immediate HO or there is still time for preparing CHO, considering serving cell’s link status. Additionally, this is not about reporting measurement results (what obviously exists in the legacy specification), but informing the NW about UE-specific aspects, not normally known to the NW, such as T310 running or not (which can have a fundamental importance in deciding if HO or CHO shall be configured). Not everything can be inferred based on measurement results. |

**Optimization S16\_7:**Discuss whether return CHO is supported or not;

This is new proposal and not aligned with agreements “UE autonomously releases CHO configuration upon successful HO/CHO or reestablishment”.

The proposal is [8]:

* Supporting company: Apple

Enabling RCHO requires following enhancements:

* If RCHO is enabled, the UE will record full configurations of the serving cell and keep it after CHO to a target cell.
* UE shall inform the target cell if it has RCHO configured when sending *RRCReconfigurationComplete* to the target cell
* Network can provide CHO conditions for return CHO back to the previous serving cell right after receiving *RRCReconfigurationComplete* message by sending a new *RRCReconfiguration* message
* Target cell informs the source about utilizing RCHO based on RAN3 decision.

The question is whether we support it in Rel-16 or not.

**Question 15: Is it needed to support retrun CHO?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| MediaTek | No | This may be considered in later releases, but not now. |
| ZTE | No | Share the same view with MediaTek. |
| OPPO | No | This may introduce a lot of work to do. |
| Futurewei | No | Not sure the benefit of quickly back and forth switching the serving cell. |
| Huawei, HiSilicon | No |  |
| Intel | No | Same view as MediaTek. |
| Sharp | NO |  |
| CATT | No |  |
| Lenovo&MM | No | Alternative better option is that UE keep source configuration for a duration after HO. For the case too-early-handover, UE can re-establish in the source cell upon RLF. |
| Samsung | No | Can be discussed in the future release. |
| Nokia | No |  |

**Optimization S16\_8:**To discuss whether CHO can be configured in the resume message;

As discussed in the email discussion 108#66,

|  |
| --- |
| **Proposal 12** CHO configuration stored in UE shall be removed by the UE when entering IDLE or INACTIVE; |

[2] proposed to support CHO configuration in resume message. It would be good to discuss this in the meeting. .

Supporting company: Ericsson

**Question 16: Is it needed to add CHO configuration in the resume message?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| MediaTek | No | We don't see the need. Upon resume, there's no latest measurement report. Resumption may even happen in another cell so early measurement reports are useless. |
| ZTE | No | Considering that the UE shall delete CHO related configuration upon entering RRC\_INACTIVE state and no available measurement results is received by the NW upon sending RRCResume message to the UE, it may have no meaning to configure CHO at this time. |
| OPPO | No | Without up-to-date measurement report, network may not find appropriate candidate cells for CHO configuration. |
| Futurewei | No | When the RRC Resume is issued, even early measurement is not available, not sure how CHO configuration could be conducted by the network. |
| Huawei, HiSilicon | No |  |
| Intel | No | Do not see the use case. |
| Sharp | No | We share ZTE’s view. |
| CATT | No | NW will be lack of the measurement on the neighbour cells. And it also requires extra standard work. |
| Lenovo&MM | No | Don’t see the benefit. |
| Samsung | No | Can be discussed in the future release. |
| Nokia | No | Agree with preceding opinions. NW has no up-to-date measurements for prepring meaningful CHO candidates after resuming the connection. |

### 2.4 Open items proposed not be treated

As proposed in [38], below issues should not be treated since they have been solved or not aligned with agreements.

**2.1 Issue 2: [1] raised for A3/A5 combination, whether original agreements “same RS type” for multiple trigger events is still valid or not**

**2.4 Issue 3 [21]: to reverse the agreements, the UE shall not autonomously remove CHO configuration upon successful HO;**

**2.7 [4] raised issue on UE context discard upon successful reestablishment or CHO**

**2.9 [10] UE reports the CHO reconfiguration failure related information to the network side, e.g. the failure indication, the failure target cell ID, the specific failure configuration..**

**2.11 [12] ask RAN2 to define a list of reconfigurations that require and do not require coordination with the target cell. A corresponding signalling is expected to be designed by RAN3**

**2.13 Issue 1: continue the measurement reporting after receiving cho-config [25]**

**2.13 Issue 2: Modification of the measurement configuration in cho-config [25]**

**2.13 Issue 3: Leaving condition based CHO reporting to allow the network to de-configure the CHO candidate(s) [25]**

**2.13 Issue 4: handling when multiple cells meet the execution condition [26]**

**UE should ignore the difference of the measurement results derived from different rsType when more than one candidate cells meet each execution condition**

**The UE should evaluate candidate cells based on the RSRP, when more than one candidate cells meet each CHO execution condition, independent of the trigger quantity configured for them**

**The UE should ignore the number difference between different rsType when evaluates the number of the beam above the threshold if multiple cells meet each CHO execution condition**

**2.3 Issue, whether the restriction on cho-RRCReconfig should be captured in the procedure or as field description**

**2.14 Issue 1: the UE should only derive/update the security keys when conditional handover is being executed;**

**2.15 issue 1:** **whether CHO is supported for NR-U, and if yes whether introduce a new event based on the channel occupancy;**

**Question 17: Do companies agree that the issues listed above should not be treated? If no, pls indicate your reason.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| MediaTek | Agree |  |
| ZTE | Yes |  |
| OPPO | Yes |  |
| Futurewei | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Intel | Yes |  |
| Sharp | Yes |  |
| Lenovo&MM | Yes |  |
| Samsung | Yes |  |
| Nokia | Agree |  |

### 2.5 Issues to be covered by other email discusions and should be treated based on email discussion report (Placeholder)

**Proposal 2-1: CHO+legacy HO command should be discussed based on email discussion 108#66;**

**Proposal 4-1: Handling of measID/reportConfig when the CHO configurations are autonomously released by the UE should be discussed based on email discussion 108#66;**

**Proposal 5-1: CHO+CPC should be discussed based on email discussion 108#67;**

**Proposal 8-1: The maximum candidate cells should be discussed based on email discussion 108#66;**

**Proposal 10-1: The support of CHO+DAPS should be discussed based on email discussion 108#66;**

**Proposal 12-1: The support of CHO+T312 should be discussed based on email discussion 108#66;**

There are clear majority in [38] for above issues. Rapporteur assume these issues can be solved based on email discussion.

**Question 18: Do companies have different view on above proposals? If yes, pls indicate your reason.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| MediaTek | No | We agree to the above proposals. |
| ZTE | No | Agree to the above proposals. |
| OPPO | No |  |
| Futurewei | Yes | We have different view on Proposal 12-1. For CHO, T310 is good enough for source link failure recovery. T312 may lead to un-necessary RLF declaration and causing more service interruption. |
| Huawei, HiSilicon | No |  |
| Intel | Yes | **Proposal 12-1: The support of CHO+T312 should be discussed based on email discussion 108#66;**  It is not treated in the meeting. Further discussion is needed. |
| Sharp | Yes |  |
| Samsung | No | **Same view** |
| Nokia | Yes | Proposal 12-1 shall be discussed further. In 108#66 there were numerous companies (ZTE, Futurewei, DCM, Nokia, QC) supporting T312 is stopped when CHO is received. We believe this shall not be ignored. |

**Copied from 108#66**

*Proposal 8 in 108#66. T312 is not stopped upon the reception of RRC Reconfiguration with cho-Config;*

|  |
| --- |
| **[37] Should the reception of RRC Reconfiguration with cho-Config stop T312, if running?**  ***Yes: 6***  ***No: 13***  Summary: No change;  Based on companies’s inputs, majority view is that T312 is not stopped upon reception of CHO command.   * Do not need additional change when merging T312 changes; |

**Question 19: Do companies have different view on below proposal? If yes, pls indicate your reason.**

*Proposal 8 in 108#66. T312 is not stopped upon the reception of RRC Reconfiguration with cho-Config;*

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| Intel | No |  |
| Sharp | No |  |
| Lenovo&MM | No |  |
| Samsung | No |  |
| Nokia | Yes | As we have pointed our in [R2-2001003](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109_e/Docs/R2-2001003.zip):  T312 is not necessary for monitoring the radio link in the serving cell after the reception of cho-Config. T310 is still available for such purpose.  T312 is used to declare fast RLF. There is no need for such immediate action when UE is prepared with CHO configurations.  After T312 expiry, in the presence of CHO configurations, the UE is not likely to recover via single CHO attempt, as multiple conditions have to be met:  - The UE supports recovery via single CHO attempt  - The NW configured the UE with such mechanism  - The selected cell in re-establishment procedure is the CHO candidate |

*Proposal 9 in 108#66. T312 is stopped upon the execution of CHO;*

|  |
| --- |
| **[37] Should T312 be stopped upon CHO execution?**  ***Yes: 17***  ***No: 2***  Summary: No change;  Based on companies’s inputs, majority view is that T312 is stopped upon execution of CHO that has been covered by T312 TP.   * Do not need additional change when merging T312 changes; |

**Question 20: Do companies have different view on below proposal? If yes, pls indicate your reason.**

*Proposal 9 in 108#66. T312 is stopped upon the execution of CHO;*

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| Intel | No |  |
| Sharp | No |  |
| Lenovo&MM | No |  |
| Samsung | No |  |
| Nokia | No | T312 is stopped earlier. But at CHO execution as well, if not stopped earlier. |

*Proposal 10 in 108#66. CHO based RLF failure handling is also applied for RLF caused by the expiry of T312;*

|  |
| --- |
| **[37] What should UE do when T312 expires if the UE has CHO configuration? i.e. should the CHO based RLF handling apply to T312 expiry?**  ***Yes: 16***  **This will not happen if T312 is stopped when CHO configuration is received: 3**  Summary: No change;  Based on companies’s inputs, majority view is that T312 expires is part of RLF, and then same behavior can be applied, i.e. CHO based RLF failure handling.   * Do not need additional change when merging T312 changes; |

**Question 21: Do companies have different view on below proposal? If yes, pls indicate your reason.**

*Proposal 10 in 108#66. CHO based RLF failure handling is also applied for RLF caused by the expiry of T312;*

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| Intel | No |  |
| Sharp | No |  |
| Lenovo&MM | No |  |
| Samsung | No |  |
| Nokia | No |  |

# Conclusion

The followings are proposed:

# References

[1] R2-2000329 Major CHO issues discussed in [108#66][NR Mob] phase-2 Ericsson

[2] R2-2000330 Major CHO issues not discussed in [108#66][NR Mob] Ericsson

[3] R2-2000374 RRC remaining issues for conditional handover configuration vivo

[4]R2-2000375 Discussion on CHO release vivo

[5]R2-2000444 On CHO execution triggering with two joint events Futurewei

[6]R2-2000445 Resource limitation on number of CHO candidates Futurewei

[7]R2-2000468 "And" events for CHO Intel Corporation

[8]R2-2000592 Consecutive CHO Apple

[9]R2-2000653 On the need of including CHO configuration in HO command OPPO

[10]R2-2000922 Further consideration on CHO compliance check failure CMCC

[11]R2-2000923 Combination of CHO and DAPS HO CMCC

[12]R2-2001002 On reconfigurations when CHO is prepared Nokia, Nokia Shanghai Bell

[13]R2-2001257 Conventional HO overriding a CHO command ZTE Corporation, Sanechips

[14]R2-2001258 CHO triggering configuration ZTE Corporation, Sanechips

[15]R2-2001259 Applicable CHO configuration ZTE Corporation, Sanechips

[16]R2-2001384 Discussion on configuration aspect for CHO Huawei, HiSilicon, China Telecom

[17]R2-2001385 Discussion on remaining issues for CHO Huawei, HiSilicon

[18]R2-2001534 Consideration of HO Command including CHO LG Electronics Inc

[19]R2-2001584 Further details of CHO configuration and execution China Telecom

[20]R2-2001637 Remaining issues for CHO execution Samsung R&D Institute UK discussion

[21]R2-2001651 Autonomous release of conditional configuration Google Inc. discussion

[22]R2-2001654 On the target to configure conditional handover Google Inc. discussion

[23]R2-2000332 Other aspects of CHO Ericsson

[24]R2-2000377 Discussion on simultaneous connectivity in CHO vivo

[25]R2-2000855 Measurement reporting while CHO is configured PANASONIC R&D Center Germany

[26]R2-2000899 Further Discussion on Cell Evaluation for CHO Cell Selection CATT

[27]R2-2000918 Discussion on CHO for DC scenarios CMCC

[28]R2-2001004 On serving cell’s radio link status reporting for CHO preparation Nokia, Nokia Shanghai Bell

[29]R2-2001305 Timing of Key Derivation in Conditional Handover Futurewei

[30]R2-2001306 Draft LS on the Timing of AS Key Derivation in Conditional Handover Futurewei

[31]R2-2001386 Discussion on combination of simultaneous connectivity and CHO Huawei, HiSilicon

[32]R2-2001535 T304 Running Issue When CHO Execution LG Electronics Inc.

[33]R2-2001537 Measurement ID Handling for CHO and CPC LG Electronics Inc.

[34]R2-2001545 CHO in NR-U LG Electronics Inc.

[35]R2-2001553 Discussion on CHO for DC scenarios CMCC, **Rap, same as [27]**

[36] R2-2000459 UE feature list for LTE and NR mobility Intel Corporation

[37] R2-2000461 Report of [108#66][LTE NR Mob] Open issues for LTE and NR mobility Intel Corporation

[38] R2-2002040 Summary of CHO in AI 6.9.3.1 and 6.9.3.3 Intel Corporation