**3GPP TSG-RAN WG4 Meeting #94-e R4-2002304**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item:** 8.3

**Source:** Intel Corporation

**Title:** Email discussion summary for RAN4#94e\_#50\_NR\_Mob\_enh\_RRM

**Document for:** Information

# Introduction

This email discussion is to address the open issues in NR mobility enhancement RRM, based on the approved WF in RAN4#93 (R4-1913436) and the status report in RP#86 (RP-192533):

* Interruption in DAPS HO D1 to down select from option 1 and option 2 in slide 2 (R4-1913436).
* Power imbalance between the source and target cells in DAPS intra-frequency HO side condition.
* TRRC\_2 in conditional handover.
* Conditional PSCell change RRM requirement.

# Topic #1: DAPS handover

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000375 | Intel | **Proposal 1: interruption for DAPS handover in Delay (1) is defined as:**

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| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length X (slotsnote 1) |
| **0** | **1** | **[1]** |
| **1** | **0.5** | **[1]** |
| **2** | **0.25 Note 2** | **[2]** |
| **Note 1: The same SCS of source cell and target cell is assumed.****Note 2: Both source cell and target cell is on FR1.** |

**Observation 1: small A3 offset (e.g. -1dB~1dB) can benefit the intra-frequency DAPS handover.****Proposal 2: add the following side condition in RRM requirement for intra-frequency DAPS handover: power imbalance between the two cells should be within [3] dB.** |
| R4-2000723 | Qualcomm | **Observation 1. In intra-frequency DAPS HO upon adding target cell, UE needs to perform basic tasks that cause interruptions and are not dependent on the SCS. Some of these tasks are as following:*** **Activating another baseband module for the target cell**
* **Adjust UE processing resources and power (e.g., clocks, memory) to reflect the increased processing demand due to target cell addition**
* **Enabling streaming of RF samples (from the same or different RF module depending on UE implementation) to the newly activated baseband module**

**Proposal 1. RAN4 to adopt option 1 for interruption time in D1 for intra-frequency DAPS HO.** **Proposal 2. RAN4 to define requirements for intra-frequency DAPS HO assuming at most 8 dB power imbalance between source and target cells.****Proposal 3. RAN4 to not define requirements for the case when CBW relationship between source and target cells are different from BWP relationship between source and target cells.** |
| R4-2001413 | Ericsson | **Proposal 1 : To support cases where the relationship of CBW of target and source cell is different to different the relationship between BWP of target and source cell, generic interruption requirements are necessary. An interruption is allowed both when the target cell is added, and the source cell is released. This allows the UE always to have its RF configured to receive CBW.****Proposal 2 : RAN4 should discuss if P1 is strictly necessary****Proposal 3 : The interruption for intra-frequency DAPS handover is specified as:**

|  |  |  |
| --- | --- | --- |
|  | **NR Slot length (ms)** | **Interruption length X (slotsnote 1)** |
| **0** | **1** | **[1]** |
| **1** | **0.5** | **[1]** |
| **2** | **0.25 Note 2** | **[2]** |
| **Note 1: The same SCS of source cell and target cell is assumed.****Note 2: Both source cell and target cell are on FR1.** |

**Proposal 4: power imbalance between the two cells should be within [6] dB.** |
| R4-2001571 | Huawei | **Proposal 1: During DAPS HO delay (1), it is suggested to use option 2 to define the interruption time Tinterrupt1.****Proposal 2: For intra-band inter-frequency DAPS HO, it is suggested to clarify that the BWP of target cell is non-overlapped with the BWP of source cell in frequency domain.****Proposal 3: Both FR1-FR2 and FR2-FR1 DAPS handover requirements need to be standardized.** |
| R4-2001797 | MTK | **Observation 1: In Rel-15 it is RAN4 consensus that adjusting RF bandwidth based on CBW or BWP is the UE’s implementation issue.****Observation 2: Key factor that determines the UE RF bandwidth adjustment during Delay (1) is whether the target bandwidth is confined within the source bandwidth. The bandwidth can be either CBW or BWP, depending on UE implementation.****Observation 3: Key factor that determines the UE RF bandwidth adjustment during Delay (2) is whether the source bandwidth is confined within the target bandwidth. The bandwidth can be either CBW or BWP, depending on UE implementation.**And we propose:**Proposal 1: RAN4 to use 1ms as the interruption length of intra-frequency DAPS handover during Delay (1) even if UE does not adjust its RF bandwidth****Proposal 2: RAN4 to decide the power imbalance between source cell and target cell for DAPS handover in the performance part discussion****Proposal 3: RF retuning time during Delay (1) is needed if either one of the following condition is true*** **CBWtarget is NOT confined within CBWsource**
* **BWPtarget is NOT confined within BWPsource.**

**Similarly, the RF retuning time during Delay (2) is needed if either one of the following condition is true*** **CBWsource is NOT confined within CBWtarget**
* **BWPsource is NOT confined within BWPtarget.**
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## Open issues summary

**Issue 1-1: Interruption in intra-frequency DAPS HO D1**

* Proposals
	+ Option 1: (Intel, Ericsson, Huawei)

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| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length X (slotsnote 1) |
| 0 | 1 | [1] |
| 1 | 0.5 | [1] |
| 2 | 0.25 Note 2 | [2] |
| Note 1: The same SCS of source cell and target cell is assumed.Note 2: Both source cell and target cell is on FR1. |

* + Option 2: (Qualcomm, MTK)

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length X (slotsnote 1) |
| 0 | 1 | [1] |
| 1 | 0.5 | [2] |
| 2 | 0.25 Note 2 | [4] |
| Note 1: The same SCS of source cell and target cell is assumed.Note 2: Both source cell and target cell is on FR1. |

* Recommended WF
	+ Need more discussion

**Issue 1-2: Power imbalance in side condition**

* Proposals
	+ Option 1: [3dB] (Intel)
	+ Option 2: [8dB] (Qualcomm)
	+ Option 3: [6dB] (Ericsson)
	+ Option 4: decided only in test case (MTK)
* Recommended WF
	+ Need more discussion

**Issue 1-3: When CBW relationship is different from that of BWP**

* Proposals
	+ Option 1: no requirements (Qualcomm)
	+ Option 2: An interruption is allowed both when the target cell is added, and the source cell is released. (Ericsson)
	+ Option 2A: (MTK)
		- RF retuning time during Delay (1) is needed if either one of the following condition is true
			* CBWtarget is NOT confined within CBWsource
			* BWPtarget is NOT confined within BWPsource.
		- RF retuning time during Delay (2) is needed if either one of the following condition is true
			* CBWsource is NOT confined within CBWtarget
			* BWPsource is NOT confined within BWPtarget.
* Recommended WF
	+ Need more discussion

**Issue 1-4: Restriction on BWP for inter-frequency DAPS HO:**

* Proposals
	+ Option 1: For inter-frequency DAPS HO, it is suggested to clarify that the BWP of target cell is non-overlapped with the BWP of source cell in frequency domain. (Huawei)
* Recommended WF
	+ Need more discussion

**Issue 1-5: Requirement for inter-FR DAPS HO:**

* Proposals
	+ Both FR1-FR2 and FR2-FR1 DAPS handover requirements need to be standardized. (Huawei)
* Recommended WF: agree to introduce both FR1-FR2 and FR2-FR1 DAPS handover requirements

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Issue 1-1: We think that 500uS should be sufficient for intra-frequency DAPS interruption in D1. For 15kHz SCS this needs to be rounded up to one slot (option 1).Issue 1-2: We think it may be beneficial to have further discussion on what the imbalance actually means. The main purpose of DAPS handover is to improve handover robustness, since the UE maintains connection to both source and target cell. In the short-medium term, either source or target may be subject to deep fading and we would expect that the DAPS connection is maintained. From this perspective imbalance may be large, at least temporarily. On the other hand, reading contributions it seems that other companies understand imbalance as a requirement, eg a power window when the UE receives successfully from both cells with a certain MCS.We certainly don’t want to see a limitation that DAPS HO can’t be used when the short term imbalance is relatively large. The tehnically endorsed CR from Reno has this TBD as a side condition of the interruption requirement, from which we have assumed that this means the imbalance needs to be satisfied over the whole interrupt duration, although it is still not clear what sort of average period it applies over. But anyway the point is we did not assume that it means that both links can be used in this condition.At any rate, we think more clarity is needed on what “imbalance” really means in a DAPS HO before discussing the options.Issue 1-3: All 3 options are feasible ways of addressing the issue We agree with Qualcomm that it is an unusual scenario where the target CBW>source CBW but target BWP<=source BWP. That means that option 1 may be preferable to our option 2 where an interrupt would be allowed at each D2 even though it is typically not needed. Option 2A is also complicating the spec quite significantly for a scenario that is not common. So we can support option 1 even though option 2 was our proposal.Issue 1-4: The issue is new, but the proposed solution seems valid.Issue 1-5: We agree DAPS HO between FR1-FR2 and FR2-FR1 should be feasible since only the FR2 link needs beamforming.….Others: |
| Intel | Issue 1-2: during DAPS handover UE needs to perform downlink reception from both source and target cell. Assuming 3dB power imbalance, UE will observe -3dB for one of these two cells. Although cell search and RRM measurement performance can be guaranteed under -6dB, PDSCH demodulation performance is quite different, which can hardly be guaranteed under such low SNR even for low MCS. Note that in real practice there are other neighbor cells which will also cause interference to the UE. Thus the actual SINR is likely to be even lower than -3dB.Issue 1-3: support option 1. Technically interruption should be allowed if there is CBW change, considering all kinds of UE implementation. However, we prefer to focus on the very common case, where CBW is not changed during the procedure. On the other hand, if target cell wants to configure different CBW for the UE, it can be done via RRC reconfiguration alone with source cell release (anyway target cell needs to release source cell via RRC).Issue 1-5: support proposals from Huawei.  |
| Nokia | Issue 1-1: Depends on the assumptions but if it is assumed that BW is the same the we would expect this could be done at least with same delay as BWP switch delay, Type-1.Issue 1-2: As in HO reporting the event reporting is often triggered at 3dB difference and hence it is expected that the UE should be able to handle even larger power imbalance. Hence, we would expect it to be higher than 3dB. We do not believe core requirements are set by test cases.Issue 1-3: We can accept Option 2.Issue 1-4: This is likely an acceptable approach. Is this limitation due to CA?Issue 1-5: Is this supported in RAN2? |
| Qualcomm | Issue 1-1: The actions that cause interruption when target cell is added, as described in our paper, is not dependent on SCS. The interruption time cannot be made smaller with larger SCS. We cannot agree to option 1. There is a distinction between interruption in this case and BWP switch delay; UE has to support simultaneous connectivity and enabled dual baseband processing. Issue 1-2: Our understanding from RAN4#93 meeting was that the power imbalance limit is specified as a side condition for applicability of interruption requirements, i.e., if the power imbalance exceeds the specified limit, UE is allowed more interruption. It should not be interpreted that DAPS HO would not work if power imbalance exceeds X dB. Some of the comments above suggest that limiting power imbalance is to ensure UE can decode PDSCH from both source and target links. If that is the intention, we really don’t see why this would be any different from power imbalance in intra-band CA (i.e., 6 dB). Also, as mentioned above, it is hard to guarantee that short term fading does not violate the X dB limit. In that case, what should the expected UE behavior be?Issue 1-4: we can agree to Huawei’s proposal. Issue 1-5: We don’t see a strong justification for enhanced mobility features in FR2 PCell and prefer to not specify inter-FR in R16. Moreover, the interruption values may have to be revisited. |
| Huawei | Issue 1-1:We propose that 0.5ms is sufficient for UE applying the BB parameter of target cell. Then, the interruption requirements can be defined as option 1.Issue 1-2:The definition of Tsearch for legacy handover is reused for DAPS handover. The value of Tsearch for unknown cell is defined under the condition of target cell Es/Iot≥[-2] dB. The power imbalance between source and target shall not be too large. We are fine to agree on option 1.Issue 1-3:We can agree on option 1.During D1, an interruption to source cell is only allowed for adding target cell. However, UE is still connected with source cell and may receive BWP switching indication. If UE perform BWP switching for source cell, there would cause the interruption.It is assumed that UE performs SSB based cell search and fine time tracking for target cell, hence, SSB shall be within target cell BWP indicated by DAPS HO command. Otherwise, UE need gaps to perform cell search and fine time tracking for target cell, which would also cause interruption to source cell. SSB is within initial BWP. Then initial BWP need to be included in target cell BWP for DAPS HO.We propose to capture the following conditions for the current DAPS handover requirements.- UE does not receive any BWP switching indication during whole DAPS HO procedure.- The target cell BWP indicated by DAPS HO command contains initial BWP.Issue 1-5:In RAN4, the feasibility of inter-FR DAPS handover has been confirmed in RAN4#91 meeting, and an LS was also sent to inform RAN1 and RAN2 the agreements. Currently, DAPS HO for FR1 to FR2 and FR2 to FR1 has not been excluded in both RAN1 and RAN2. We propose to define both FR1 to FR2 and FR2 to FR1 DAPS HO requirement. The inter-FR HO is also a kind of inter-band HO. The existing interruption requirements due to PSCell/SCell addition/release can be reused. |
| MediaTek | **Issue 1-1: Interruption in intra-frequency DAPS HO D1**[MTK]: Support option 2 to allow UE to re-allocate some baseband and RF chain resources. Here, we assume that UE does not need to conduct any RF-retuning in D1. **Issue 1-2: Power imbalance in side condition**[MTK]: Our understanding is that limiting power imbalance is to ensure UE can decode PDSCH from both source and target cells. Considering that power imbalance in intra-band CA (i.e., 6 dB) is determined in performance part, so we suggest to specify it only in test case. If the interpretation is “UE is allowed more interruption when power imbalance exceeds the specified limit,” we wonder what is the expected UE behavior when power imbalance exceeds the specified limit? Will we define a longer interruption time for this case? As mentioned, it is hard to guarantee that short term fading does not violate the X dB limit. From UE perspective, it seems that UE no matter what needs a longer interruption time. We believe that the intention to specify a particular interruption time for UE is to test the UE performance in particular scenario, based on the assumption that some ideal conditions are met. So we believe it will be more appropriate to determine the power imbalance value when we discuss the parameter setting in performance part. We don’t have to discuss whether the short term fading will violate the X dB limit or not, because we can assume that the testing environment is very ideal.**Issue 1-3: When CBW relationship is different from that of BWP**[MTK]: We prefer to clarify the definitions of intra-freq. DAPS handover and inter-freq. DAPS handover. In RRM measurement, the definitions of intra/inter-freq. measurement are:* Intra-freq. measurement: the centre frequency of the SSB of the serving cell indicated for measurement and the centre frequency of the SSB of the neighbour cell are the same, and the subcarrier spacing of the two SSBs are also the same
* Inter-freq. measurement: if it is not intra-freq. measurement.

However, RAN4 has never agreed on definitions of so-called intra-freq. DAPS handover and inter-freq. DAPS handover. **Issue 1-4: Restriction on BWP for inter-frequency DAPS HO:**[MTK]: We prefer to clarify the definitions of intra-freq. DAPS handover first. Then we can assert that as long as it is not intra-freq. DAPS handover, it is inter-freq. DAPS handover. |
| NEC | Issue 1-1: We support option 1Issue 1-2: We support option 4Issue 1-3: We are OK with option 1 |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

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| **CR/TP number** | **Comments collection** |
| R4-2000376 | Ericsson : Need to conclude discussion on imbalance and other open issues |
|  Qualcomm: we have brought a CR to LTE DAPS (R4-2001840) where most of the suggested corrections should also apply to NR DAPS. It would be good if those changes, if agreed, are also ported to NR spec. |
| xxx |
| R4-2001414 | Company A |
| Company B |
| xxx |
| R4-2001572 | Ericsson : There are TBDs and editors notes left remaining by this CR which we would prefer to see progress on during this meeting. |
|  Qualcomm: As mentioned above, we prefer not to add inter-FR scenarios. |
| Huawei: The TBDs can be updated based on the agreements in this meeting. |
| xxx |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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| --- | --- |
|  | **Status summary**  |
| **Issue 1-1** | **Interruption in intra-frequency DAPS HO D1:***Tentative agreements:* *No agreement in the 1st round.**Candidate options:**o Option 1: 500us interruption, rounded up to number of slot. (Intel, Ericsson, Huawei, NEC)**o Option 2: 1ms interruption, rounded up to number of slot. (QC, MTK)**Recommendations for 2nd round: continue discussion.* |
| **Issue 1-2** | **Power imbalance in side condition***Tentative agreements:* *No agreement in the 1st round.**Candidate options:**o Option 1: [3dB] (Intel)**o Option 2: [8dB] (Qualcomm)**o Option 3: [6dB] (Ericsson)**o Option 4: decided only in test case (MTK, NEC)**Recommendations for 2nd round: continue discussion* |
| **Issue 1-3** | **When CBW relationship is different from that of BWP***Tentative agreements: no requirements for CBW relationship is different from that of BWP**Candidate options: N/A**Recommendations for 2nd round: N/A* |
| **Issue 1-4** | **Restriction on BWP for inter-frequency DAPS HO***Tentative agreements: For inter-frequency DAPS HO, the BWP of target cell is non-overlapped with the BWP of source cell in frequency domain.**Candidate options: N/A**Recommendations for 2nd round: clarify the definitions of intra-freq. DAPS handover first. Then we can assert that as long as it is not intra-freq. DAPS handover, it is inter-freq. DAPS handover.* |
| **Issue 1-5** | **Requirement for inter-FR DAPS HO***Tentative agreements: Both FR1-FR2 and FR2-FR1 DAPS handover requirements need to be standardized.**Candidate options: N/A**Recommendations for 2nd round: N/A* |

*Recommendations on WF/LS assignment*

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| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | Way forward for NR mobility enhancement | Intel |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| R4-2001572 | *to be revised* |

## Discussion on 2nd round (if applicable)

**Issue 1-1: Interruption in intra-frequency DAPS HO D1**

* Proposals
	+ Option 1: (Intel, Ericsson, Huawei, NEC)

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| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length X (slotsnote 1) |
| 0 | 1 | [1] |
| 1 | 0.5 | [1] |
| 2 | 0.25 Note 2 | [2] |
| Note 1: The same SCS of source cell and target cell is assumed.Note 2: Both source cell and target cell is on FR1. |

* + Option 2: (Qualcomm, MTK)

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length X (slotsnote 1) |
| 0 | 1 | [1] |
| 1 | 0.5 | [2] |
| 2 | 0.25 Note 2 | [4] |
| Note 1: The same SCS of source cell and target cell is assumed.Note 2: Both source cell and target cell is on FR1. |

* Recommended WF
	+ Need more discussion

**Issue 1-2: Power imbalance in side condition**

* Proposals
	+ Option 1: [3dB] (Intel)
	+ Option 2: [8dB] (Qualcomm)
	+ Option 3: [6dB] (Ericsson)
	+ Option 4: decided only in test case (MTK)
* Recommended WF
	+ Need more discussion

**Issue 1-4: Restriction on BWP for inter-frequency DAPS HO:**

* Agreements in the 1st round:
	+ For inter-frequency DAPS HO, it is suggested to clarify that the BWP of target cell is non-overlapped with the BWP of source cell in frequency domain.
* Recommended WF
	+ Companies are encouraged to discuss the definition of intra-freq. and inter-freq. DAPS handover in the 2nd round.

## Companies views’ collection for 2nd round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| Intel | **Issue 1-1: Interruption in intra-frequency DAPS HO D1:**There are two options on the table:*o Option 1: 500us interruption, rounded up to number of slot. (Intel, Ericsson, Huawei, NEC)**o Option 2: 1ms interruption, rounded up to number of slot. (QC, MTK)*To move forward, Intel suggests another option between option 1 and 2, e.g.: 750us, which seems to be agreeable to Nokia as well. New proposal: Option 3:

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length X (slotsnote 1) |
| 0 | 1 | [1] |
| 1 | 0.5 | [2] |
| 2 | 0.25 Note 2 | [3] |
| Note 1: The same SCS of source cell and target cell is assumed.Note 2: Both source cell and target cell is on FR1. |

**Issue 1-2: Power imbalance in side condition**We also believe it is better to clarify what “power imbalance” really means and we agree with Qualcomm that the power imbalance limit is specified as a side condition for applicability of interruption requirements, i.e., if the power imbalance exceeds the specified limit, UE is allowed more interruption.With this clarification, [3dB] is still our preference. First of all we would like to clarify that this side condition was added in Reno meeting under agreement for **intra-frequency** DAPS handover. In intra-frequency DAPS handover the source and target cells contribute interference to each other. This is unlike power imbalance in intra-band CA, where each CC would not cause interference to each other. Although the two links may not always collide with each other during the procedure, we still need to consider the case where there is DL collision since we usually define requirement for the worst case. In case of DL collision, with 3dB power imbalance the SNR of one of the two cells would become lower than -3dB (actually it could be even lower in real practise since there are also other neighbour cells which would cause interference). Under such low SNR condition UE may have problem in DL reception, in terms of causing more interruption to network. We agree that temporary large power imbalance is difficult to avoid in real network and we also expect that DAPS handover should be maintained even with higher power imbalance. But we also need to face the fact that when there is large power imbalance more interruption shall be expected.**Issue 1-4: Restriction on BWP for inter-frequency DAPS HO:**So far, we don’t have clear definition of intra-freq. and inter-freq. DAPS handover. Our suggestion is to develop these definitions based on that of intra/inter-freq. measurement. We can also add condition w.r.t. active BWP restriction. E.g.:* Intra-frequency DAPS handover: A DAPS handover is defined as an intra-frequency DAPS handover provided
	+ the centre frequency of the SSB of the serving cell indicated for measurement and the centre frequency of the SSB of the neighbour cell are the same, and
	+ the subcarrier spacing of the two SSBs are also the same

Note: no requirement if active DL and UL BWP of target cell is not confined within the active DL and UL BWP of the source cell respectively* Inter-frequency DAPS handover: if it is not intra-frequency DAPS handover

Note: no requirement if BWP of target cell is non-overlapped with the BWP of source cell in frequency domain. |
| Ericsson | **Issue 1-1: Interruption in intra-frequency DAPS HO D1:**We could accept the compromise proposed by Intel in 2nd round of 750µS, although we still prefer option1**Issue 1-2: Power imbalance in side condition**Our understanding is also that “power imbalance” should not be a demod condition, but a side condition applying throughout in which we expect DAPS handover procedure to succeed with the RAN4 requirements met. So it should be a side condition to both delay and interruption requirements.With that understanding we definitely cannot accept a value greater than -6dB. With the understanding that such imbalance is not an instantaneous imbalance but an average difference over eg 1 slot, -6dB seems reasonable. Instantaneous imbalance due to fast fading can easily be much greater than 6dB.We would also like to clarify if this imbalance requirement applies to all DL signals, or to SSB SNR. Our view is the latter, and perhaps the best way to capture this aspect in specifications is to have a requirement on SSB Es/Iot>=-6dB for both cells until the source cell is successfully released.**Issue 1-4: Restriction on BWP for inter-frequency DAPS HO:**The definition from first round seems good. We should be careful not to confuse this with the definition of intra vs interfrequency measurements. If the BWP of the target cell is fully overlapped with the BWP of the source cell then retuning interruptions should follow intrafrequency operation. There could be intrafrequency HO between two cells where the SSBs are interfrequency according to the definition for measurements. Perhaps we need to make a new terminology for the handover requirements to avoid this confusion eg talk about“DAPS handover where the active DL BWP of the target fully overlaps the active DL BWP of the source”And“DAPS handover where the active DL BWP of the target either partially overlaps the active DL BWP of the source or does not overlap with the DL BWP of the source”**Issue 1-4**  |
| Qualcomm | **Issue 1-1:** QC can also compromise and accept the proposal by Intel in the 2nd round.**Issue 1-2:**We’d like to note that interruptions in RRM tests are verified through HARQ feedback of UE. So if UE cannot perform demod correctly in RRM tests, then it is considered as interruption. In this sense, power imbalance is related to demod performance. We also don’t understand why the power imbalance should be applicable to SSB SNR. UE is supposed to decode PDSCH from two links and the two PDSCH packets can interfere with each other whereas SSBs may not and vice versa. So power imbalance should not be specific to SSB. In terms of the actual value, we can compromise to a smaller value.**Issue 1-4:**We can agree to Ericsson’s suggestion but as mentioned in Intel’s proposal, there should also be the same SCS and same CP condition between source and target BWPs.  |
| Huawei | **Issue 1-1: Interruption in intra-frequency DAPS HO D1:**We can compromise to option 3 proposed by Intel in 2nd round.**Issue 1-2: Power imbalance in side condition**During DAPS handover procedure, both target cell and source cell shall at least be detectable, i.e.,Es/Iot>-6dB. If the power imbalance is larger than 6dB, then either source cell or target cell would become undetectable. The cell search time for unknown target cell is defined under the condition of target cell Es/Iot>[-2] dB. The power imbalance between source and target shall be a small value. Power imbalance within 3dB seems reasonable.**Issue 1-4: Restriction on BWP for inter-frequency DAPS HO:**We agree Intel’s suggestion to develop these definitions based on that of intra/inter-freq measurement. For inter-frequency DAPS handover, no requirement if BWP of target cell is overlapped with the BWP of source cell in frequency domain. |
| MTK | **Issue 1-1: Interruption in intra-frequency DAPS HO D1:**We need to further study on option 3 proposed by Intel in 2nd round.**Issue 1-2: Power imbalance in side condition**We share the same view with QC, power imbalance is related to demod performance. Considering that power imbalance for demod performance only specified in test case, we suggest to continue this discussion in performance part.**Issue 1-4: Restriction on BWP for inter-frequency DAPS HO:**Basically, we think that we should combine Ericsson’s proposal and Intel’s proposal. A DAPS handover is defined as an intra-frequency DAPS handover provided:* the centre frequency of the SSB of the serving cell indicated for measurement and the centre frequency of the SSB of the neighbour cell are the same, and
* the subcarrier spacing of the two SSBs are also the same
* active DL BWP of the target fully overlaps the active DL BWP of the source

Inter-frequency DAPS handover: if it is not intra-frequency DAPS handover |

## Summary on 2nd round (if applicable)

### Open issues

*Moderator tries to summarize discussion status for 2st round, list all the identified open issues and tentative agreements.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 1-1** | **Interruption in intra-frequency DAPS HO D1:***Tentative agreements:* *Interruption for intra-frequency DAPS handover is defined as*

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length X (slotsnote 1) |
| 0 | 1 | [1] |
| 1 | 0.5 | [2] |
| 2 | 0.25 Note 2 | [x] |
| Note 1: The same SCS of source cell and target cell is assumed.Note 2: Both source cell and target cell is on FR1. |

*X value:*1. *Option 1: 3 (slots)*
2. *Option 2: 4 (slots)*
 |
| **Issue 1-2** | **Power imbalance in side condition***Tentative agreements:* *No agreement. Further discussion is needed.* |
| **Issue 1-4** | **Restriction on BWP for inter-frequency DAPS HO***Tentative agreements: RAN4 will not define requirement for the case where the BWP of target cell is partial overlapped with the BWP of source cell in frequency domain.* |

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| R4-2002223 | *agreeable* |
| R4-2002224 | *agreeable* |

# Topic #2: Conditional handover

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000377 | Intel | **Proposal 1: TRRC\_2 is [10ms], as long as TRRC\_1 + TRRC\_2 will not significantly exceed the total RRC processing delay in conventional handover.** |
| R4-2000724 | Qualcomm | **Observation 1. Many steps in TS 38.331 cannot be executed until the first condition specified in the conditional HO command is met since:*** **only in that instance of time the identity of the target cell is known**
* **UE can prematurely declare RLF if some of the steps are executed as it is possible that the conditions configured in CHO command are never met**

**Proposal 1. For both NR and LTE conditional HO, TCHO\_execution = 10ms.** |
| R4-2001337 | Nokia | 1. Remove *TCHO\_execution* from Dhandover for conditional handover.
2. Update the reference to inter-frequency section.
3. Measurement delay would need to be considered in the CHO measurement time.
4. Update sections 6.1.1.7,6.1.1.8 and 6.1.1.9
5. Refer from sections 6.1.1.7, 6.1.1.8 and 6.1.1.9 to the generic NR CHO requirements in section 6.1.1.6.
6. Agree on the text proposal.
 |
| R4-2001415 | Ericsson | **Proposal 1 : Trrc2 is specified as [5]ms****Observation 1: Conditional PSCell addition or release is not within the scope of release 16 mobility enhancements since it involves the MN****Proposal 2 : No additional requirements are needed for PSCell addition, release or change in 36.133** |
| R4-2001573 | Huawei | **Proposal 1: For conditional HO, the time period Tmeasure can be defined as:****Tmeasure= TEvent\_DU + Tmeasure\_delay****Where****TEvent\_DU is the delay uncertainty in waiting an event that will trigger a CHO after UE successfully decoding the RRC message including CHO execution conditions.****Tmeasure\_delay is the measurement delay between the event that will trigger a CHO and the point when the UE starts to execute CHO. Tmeasure\_delay is same as the measurement reporting delay defined in existing event triggered reporting requirements.****Proposal 2: The values of TRRC\_2 used in conditional HO delay requirements can be defined as 13ms.** |
| R4-2001798 | MTK | **Proposal 1: Reuse the existing processing time for RRC reconfiguration message to specify the required time of TRRC\_2.** |

## Open issues summary

**Issue 2-1: TRRC\_2/TCHO\_execution:**

* Proposals
	+ Option 1: [10ms] (Intel, Qualcomm, MTK)
	+ Option 2: [5ms] (Ericsson)
	+ Option 3: [13ms] (Huawei)
	+ Option 4: Remove *TCHO\_execution* from Dhandover for conditional handover (Nokia)
* Recommended WF
	+ Agree on option 1.

**Issue 2-2: Reformulate Tmeasure:**

* Proposals
	+ Option 1: (Huawei)

Tmeasure= TEvent\_DU + Tmeasure\_delay

Where:

* TEvent\_DU is the delay uncertainty in waiting an event that will trigger a CHO after UE successfully decoding the RRC message including CHO execution conditions.
* Tmeasure\_delay is the measurement delay between the event that will trigger a CHO and the point when the UE starts to execute CHO. Tmeasure\_delay is same as the measurement reporting delay defined in existing event triggered reporting requirements.
	+ Option 2: keep previous agreement
* Recommended WF
	+ Need more discussion

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Issue 2-1: The recommended way forward to agree on option 1 is OK for us as a compromise. 10ms is very significantly shorter than the shortest NR measurement period (200ms) so the exact value is not extremely critical to system performance.Issue 2-2: The motivation to split Tmeasure isn’t really clear after reading R4-2001573. I also didn’t find a CR or TP related to this. It would be easier to agree or otherwise on splitting Tmeasure after seeing how the new definition is proposed to be used in the spec.….Others: |
| Intel | Issue 2-1: prefer option 1. Option 3 seems longer than legacy RRC processing delay, which is 10ms as defined in TS38.133.Issue 2-2: support option 1.  |
| Nokia | Issue 2-1: It seems Nokia’s proposal was missing – now added. The current delay is already very relaxed and hence we see this delay as being redundant or at most very short. For the sake of progress we can support Option 2.Issue 2-2: This is our understanding already captured in the current delay. Hence, we prefer option 2. |
| Qualcomm | Issue 2-1: we support option 1. We’d like to mention that this parameter is not just about the delay but it also specifies the beginning of the interruption window. Issue 2-2: We also don’t understand the motivation behind Huawei’s proposal. In our view, the description of TEvent\_DU hints at TTT but it was previously agreed in RAN4 that this would not be any different than event-triggered measurement reporting. |
| Huawei | Issue 2-1:We are fine to define Trrc2 as the legacy RRC processing delay. We can agree on option 1.Issue 2-2:Based on the endorsed CR in last meeting, Tmeasure only include two parts: TTT and the measurement delay. Tmeasure is defined as the time period between the end of Trrc1 and the start of Trrc2. However, during Tmeasure, there may exist a time period that target cell is neither detectable nor satisfying CHO condition, which is not included in current version.We suggest to use TEvent\_DU instead of TTT. TEvent\_DU includes TTT and the missing part. |
| MediaTek | **Issue 2-1: TRRC\_2/TCHO\_execution:**[MTK]: Support option 1. **Issue 2-2: Reformulate Tmeasure:**[MTK]: I remember that companies agree that TTT will always be set to zero when it goes to test cases.  |
| NEC | Issue 2-1: Support option 2. Issue 2-2: Support Option 2. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2000378 | Ericsson : No major concern with CR |
|  Qualcomm: We brought a CR to make some corrections to LTE CHO (R4-2001839) and believe many of those, if agreed, can also be applicable and ported to NR version.  |
| Huawei: The definition of Tmeasure need to be revised. 2ms margin need to be added for fine time tracking. |
| xxx |
| R4-2001338 | Ericsson : Section 6.1.4.3.1 contains some references to 6.1.1.7.x which should I think be 6.1.4.3.x. In section 6.1.4.3.1 Tprocessing should be 40ms (FR2-FR2 HO)  |
|  Qualcomm: We brought a CR to make some corrections to LTE CHO (R4-2001839) and believe many of those, if agreed, can also be applicable and ported to NR version.  |
| xxx |
| R4-2001416 | Qualcomm: We brought a CR to make some corrections to LTE CHO (R4-2001839) and believe some of them, if agreed, can also be applicable and ported to NR version. |
| Company B |
| xxx |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 2-1** | **TRRC\_2/TCHO\_execution***Tentative agreements:**TRRC\_2/TCHO\_execution is defined as [10ms]**Candidate options: TRRC\_2/TCHO\_execution is defined as [5ms], Ericsson and Nokia support this option. But Ericsson can compromise to the tentative agreement.**Recommendations for 2nd round: try to agree on tentative agreement. Otherwise continue discussion.* |
| **Issue 2-2** | **Reformulate *Tmeasure*****to *Tmeasure= TEvent\_DU + Tmeasure\_delay****Tentative agreements: no agreement in 1st round**Candidate options: keep previous agreed framework.**Recommendations for 2nd round: some companies think TEvent\_DU hints at TTT. However, Huawei clarify that there may exist a time period that target cell is neither detectable nor satisfying CHO condition, which is not included in the endorsed CR in RAN4#93. Companies are suggested to further elaborate their view based on CR R4-2001338. Check if the total handover delay is complete.* *Companies can also propose wording for the CR (e.g. upload to the same folder in FTP). It could be easier to proceed if companies can see the whole picture.*  |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | Way forward for NR mobility enhancement | Intel |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| R4-2001338 | *to be revised* |

## Discussion on 2nd round (if applicable)

**Issue 2-1: TRRC\_2/TCHO\_execution:**

* Proposals
	+ Option 1: [10ms] (Intel, Qualcomm, MTK, Ericsson)
	+ Option 2: [5ms] (Ericsson, Nokia)
* Recommended WF
	+ Agree on option 1.

**Issue 2-2: Reformulate Tmeasure:**

* Proposals
	+ Option 1: (Huawei)

Tmeasure= TEvent\_DU + Tmeasure\_delay

Where:

* TEvent\_DU is the delay uncertainty in waiting an event that will trigger a CHO after UE successfully decoding the RRC message including CHO execution conditions.
* Tmeasure\_delay is the measurement delay between the event that will trigger a CHO and the point when the UE starts to execute CHO. Tmeasure\_delay is same as the measurement reporting delay defined in existing event triggered reporting requirements.
	+ Option 2: keep previous agreement
* Recommended WF
	+ Need more discussion. Proponent is suggested to elaborate more about the issue.

## Companies views’ collection for 2nd round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | **Issue 2-1: TRRC\_2/TCHO\_execution:**It was agreed several meetings ago that RAN4 will split RRC processing time into two parts. It is common understanding (can be found in many contributions in RAN4#93) that the operations in the second part contributes most to the total RRC processing delay. The total RRC processing delay for conventional handover is captured in TS38.331, in the order of 10ms. In our understanding TRRC\_1 will take up to only 2 or 3ms, which is quite short compared with the total RRC processing delay. Therefore we prefer to keep TRRC\_2 as 10ms.**Issue 2-2: Reformulate Tmeasure:**In the endorsed CR in Reno (R4-1915782) it was captured that:

|  |
| --- |
| When the UE receives a RRC message implying conditional handover the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover seconds from the end of the last TTI containing the RRC command:Where:Dhandover equals the maximum RRC procedure delay to be defined in clause12 in TS 38.331 [2] plus the measurements time stated in clause 6.1.1.6.2 plus the conditional execution preparation time in clause 6.1.1.6.3 plus the interruption time stated in clause 6.1.1.6.4.6.1.1.6.2 Measurement timeThe measurement time delay is defined as the time between the RRC procedure delay and the point when the UE executes a handover to a target cell and preparation time starts.The measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than T identify intra with index or T identify inter without index defined in clause 9.2.5.1 or clause 9.2.6.2. When TTT or L3 filtering is used an additional delay can be expected.… |

It seems the missing part is there may exist a time period that target cell is not satisfying CHO condition. To address this we are fine to either reformulate Tmeasure or update the wording in definition of measurement time. |
| Ericsson | **Issue 2-1: TRRC\_2/TCHO\_execution:**As indicated in 1st round we can accept TRRC\_2 as 10ms as a compromise.**Issue 2-2: Reformulate Tmeasure:**Basically we agree with the change, since we have been commenting since the beginning of the discussion in RAN4 that there are two phases; conditional handover may be configured with multiple target cells, and typically in the beginning the condtion is not met. The UE performs measurements according to very similar processing as it would do to evaluate measurement events, and if the condition is met (at the UE antenna connector) the UE will take a time consistent with event triggered reporting to then determine that the condition is met. After that starts the execution phase.However, the reason we have not yet agreed with the proposal is that although there is a proposal in R4-2001573, we have not seen the corresponding CR. Nokia CR in R4-2001338 was removing TCHO\_execution and related to issue 2-1. So we need to see a CR before saying all is well with this proposal. |
| Qualcomm | **Issue 2-1:**We agree with Intel’s views. There is very little that UE can do in T\_RRC,1 before the identity of the target cell becomes known. We support option 1.**Issue 2-2:** The new explanations from companies clarify that the issue is not related to TTT. Hence, we can agree to the proposal to HW in principal but we also need to see how this is captured in the CR. |
| Huawei | **Issue 2-1:**We can agree on option 1.**Issue 2-2:** We prefer to use the wording in Intel’s CR to define the total conditional handover delay, which is DCHO = TRRC + Tmeasure + TCHO\_execution+ TinterruptTmeasure can be specified as follows:

|  |
| --- |
| Tmeasure is defined as the time period from UE successfully decoding the RRC message including CHO execution condition for target cell until UE starts to execute conditional handover to the target cell.Tmeasure= TEvent\_DU + Tmeasure\_delayWhereTEvent\_DU is the delay uncertainty in waiting an event that will trigger the conditional handover to the target cell after UE successfully decoding the RRC message including CHO execution condition.Tmeasure\_delay is the measurement delay between the event that will trigger the conditional handover to the target cell and the point when the UE starts to execute conditional handover to the target cell. For intra-frequency target cell, Tmeasure\_delay shall be less than Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index as defined in clause 9.2.5.1 or clause 9.2.6.2. When L3 filtering is used an additional delay can be expected. The target cell is detectable only if at least one SSBs measured from the target cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index as defined in clause 9.2.5.1 or clause 9.2.6.2. If the target cell which has been detectable at least for the time period Tidentify intra without index or Tidentify intra with index defined in clause 9.2.5.1 or clause 9.2.6.2 becomes undetectable for a period and then the cell becomes detectable again with the same spatial reception parameter and triggers an CHO event, Tmeasure\_delay shall be less than TSSB\_measurement\_period\_intra provided the timing to that the target cell has not changed more than ± 3200 Tc while the measurement gap has not been available and L3 filtering has not been used. When L3 filtering is used, an additional delay can be expected.For inter-frequency target cell, Tmeasure\_delay shall be less than Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index defined in clause 9.3.4. When L3 filtering is used an additional delay can be expected. The target cell is detectable only if at least one SSB measured from the target cell being configured remains detectable during the time period Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index defined in clause 9.3.4. If a cell which has been detectable at least for the time period Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index defined in clause 9.3.4 becomes undetectable for a period and then the cell becomes detectable again with the same spatial reception parameter and then triggers an CHO event, Tmeasure\_delay shall be less than TSSB\_measurement\_period\_inter defined in clause 9.3.5 provided the timing to that cell has not changed more than ± 3200 Tc while measurement gap has not been available and the L3 filtering has not been used. When L3 filtering is used an additional delay can be expected.… |

  |
| Nokia | Issue 2-1: We can compromize to option 1.Issue 2-2: It is still unclear what TEvent\_DU covers. We already have following:The measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than T identify intra with index or T identify inter without index defined in clause 9.2.5.1 or clause 9.2.6.2. When TTT or L3 filtering is used an additional delay can be expectedWe have the TRRC which is clear. Tmeasure should be clear and described above. Our understanding is that it covers from when the RRC processing is done and UE starts to measure possible candidates. Once a CHO condition is fulfilled the UE will execute the CHO once the event has been fulfilled for TTT and any possible L3 delay. As Tmeasure now excludes the TTT and L3 filter delay (or Ue is allowed additional time if these are configured) it is unclear exactly what TEvent\_DU covers. Are we discussing the L1 filter in UE? |

## Summary on 2nd round (if applicable)

### Open issues

*Moderator tries to summarize discussion status for 2st round, list all the identified open issues and tentative agreements.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 2-1** | **TRRC\_2/TCHO\_execution:***Tentative agreements:* *TRRC\_2/TCHO\_execution = 10ms* |
| **Issue 2-2** | **Reformulate Tmeasure:***Tentative agreements:* *Tmeasure is updated to cover the following two parts:*1. *Delay uncertainty which is the time from when the UE successfully decodes a CHO command until a condition exists at the measurement reference point which will trigger the CHO.*
2. *Measurement event evaluation delay which begins once the delay uncertainty ends, and ends when the UE starts to execute CHO*
 |

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| R4-2002226 | *withdrawn* |

# Topic #3: Conditional PSCell addition/change

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000379 | Intel | **Observation 1: RAN4 doesn’t need to define RRM requirement for conditional PSCell addition.****Proposal 1: conditional NR PSCell change RRM requirements are defined in TS38.133, covering both EN-DC and NR-DC.****Proposal 2: conditional PSCell change delay is defined as:****TCPC = TRRC\_1 + Tmeasure + TRRC\_2 + Tprocessing + Tsearch + T∆ + TPSCell\_ DU + 2 ms** |
| R4-2000725 | Qualcomm | **Proposal 1. RAN4 to capture NR PSCell addition/change requirements within EN-DC in TS 36.133 and NR PSCell addition/change requirements within NR-DC in TS 38.133.** **Proposal 2. Conditional PSCell addition delay is formulated as:****Tconfig\_PSCell\_Conditional = TRRC\_processing + Tmeasure + TUE\_preparation + Tprocessing + T∆ + TPSCell\_ DU + 2 ms****Where** **TRRC\_processing : is the RRC processing to process the conditional PSCell addition command which is not larger than currently defined TRRC\_processing in TS 36.133 and TS 38.133 and begins when UE receives the RRC command for conditional PSCell addition.****Tmeasure : is the from the end of RRC processing time to when until UE realizes the condition(s) for at least one of the PSCell candidates is/are met. When PCell is E-UTRA, the measurement period is bounded by Tidentify\_NR\_with\_index as defined in clause 8.17.4 of TS 36.133. When PCell lis NR, the measurement period is bounded by Tidentify\_inter\_with\_index as defined in clause 9.3.4 of TS 38.133.****TUE\_preparation : is the UE preparation time for conditional PSCell addition and starts after UE realizes the condition is met and identity of PSCell is determined. Its value is FFS but not larger than currently defined TRRC\_processing in TS 36.133 and TS 38.133.****T∆ : is the time for fine time tracking and acquiring full timing information of the target PSCell as in existing requirements.** **Tprocessing : is the SW processing time needed by UE as in existing requirements****TPSCell\_ DU : is the delay uncertainty in acquiring first available PRACH occasion in the NR PSCell as in existing requirements.** **Proposal 3. The conditional PSCell change delay requirements can be formulated as below:****Tconfig\_PSCell\_Conditional = TRRC\_processing + Tmeasure + TUE\_preparation + Tprocessing + T∆ + TPSCell\_ DU + 2 ms****Where** **Tmeasure : is the from the end of RRC processing time to when until UE realizes the condition(s) for at least one of the PSCell candidates is/are met. For intra-frequency PSCell change, the measurement period is bounded by Tidentify\_intra\_with\_index as defined in clause 9.2.4 of TS 38.133. For inter-frequency PSCell change, the measurement period is bounded by Tidentify\_inter\_with\_index as defined in clause 9.3.4 of TS 38.133.****TUE\_preparation : is the UE preparation time for conditional PSCell change and starts after UE realizes the condition is met and identity of new PSCell is determined. Its value is FFS and it may include some RRC processing related to release of the existing PSCell.** **All the other terms in the above formula are similar to those in Proposal 2.**  |
| R4-2001574 | Huawei | **Proposal 1: The conditional PSCell addition/change delay can be defined a**s **Tconfig\_CPAC:****Tconfig\_CPAC = TRRC\_1 + Tmeasure + TRRC\_2 + Tprocessing + T∆ + TPSCell\_ DU + 2 ms****Where****TRRC\_1 is the RRC processing time for RRC reconfiguration message containing conditional PSCells addition execution conditions and candidate PSCell configuration.****Tmeasure is the time period from the time when UE successfully decoded CPAC RRC command until UE detects an event for CPAC.****TRRC\_2 is the RRC processing time for applying target PSCell configuration.****Tprocessing, T∆ and TPSCell\_ DU are defined same as legacy PSCell addition/change.****Proposal 2: The interruption at conditional PSCell addition/change shall be allowed only after UE detects an event for CPAC.** |
| R4-2001415 | Ericsson | **Proposal 1 : Trrc2 is specified as [5]ms****Observation 1: Conditional PSCell addition or release is not within the scope of release 16 mobility enhancements since it involves the MN****Proposal 2 : No additional requirements are needed for PSCell addition, release or change in 36.133** |

## Open issues summary

**Issue 3-1: Conditional PSCell addition/release:**

* Proposals
	+ Option 1: no requirement is needed in this work item (Intel, Ericsson)
	+ Option 2: RAN4 to capture NR PSCell addition requirements within EN-DC in TS 36.133 and NR PSCell addition requirements within NR-DC in TS 38.133 (Qualcomm)
* Recommended WF
	+ Requirements for conditional PSCell addition/release are not needed in this work item.

**Issue 3-2: Where to capture conditional PSCell change**

* Proposals
	+ Option 1: capture in TS38.133 only (Intel, Ericsson)
	+ Option 2: capture in both TS 36.133 and TS 38.133 (Qualcomm)
* Recommended WF
	+ Capture in TS38.133 only

**Issue 3-3: Conditional PSCell change delay:**

* Proposals
	+ Option 1: (Qualcomm, Intel, Huawei)

Tconfig\_PSCell\_Conditional = TRRC\_processing + Tmeasure + TUE\_preparation + Tprocessing + T∆ + TPSCell\_ DU + 2 ms

Where

**TRRC\_processing**: is the RRC processing to process the conditional PSCell addition command which is not larger than currently defined TRRC\_processing in TS 36.133 and TS 38.133 and begins when UE receives the RRC command for conditional PSCell change.

**Tmeasure**: is the from the end of RRC processing time to when until UE realizes the condition(s) for at least one of the PSCell candidates is/are met. For intra-frequency PSCell change, the measurement period is bounded by Tidentify\_intra\_with\_index as defined in clause 9.2.4 of TS 38.133. For inter-frequency PSCell change, the measurement period is bounded by Tidentify\_inter\_with\_index as defined in clause 9.3.4 of TS 38.133.

**TUE\_preparation**: is the UE preparation time for conditional PSCell change and starts after UE realizes the condition is met and identity of new PSCell is determined. Its value is FFS and it may include some RRC processing related to release of the existing PSCell.

**T∆:** is the time for fine time tracking and acquiring full timing information of the target PSCell as in existing requirements.

**Tprocessing:** is the SW processing time needed by UE as in existing requirements

**TPSCell\_ DU:** is the delay uncertainty in acquiring first available PRACH occasion in the NR PSCell as in existing requirements.

* Recommended WF
	+ Agree on option 1.

**Issue 3-4: Interruption during conditional PSCell change:**

* Proposals
	+ Option 1: The interruption at conditional PSCell addition/change shall be allowed only after UE detects an event for CPAC. (Huawei)
* Recommended WF
	+ Agree on option 1.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Issue 3-1: We support the recommended WF since conditional PS addition/removal would involve MN. Issue 3-2: This is linked to issue 3-1. As there are no PSCell change requirements in 36.133, there is also no need for conditional PSCell change requirements in 36.133 so we agree with the recommended way forward.Issue 3-3 : Formula seems OK.Issue 3-4 : Agree, UE should not start executing conditional HO, nor interrupt….Others: |
| Intel | Issue 3-1: conditional PSCell addition is not likely to be supported in this work item.Issue 3-2: there is even no PSCell change requirement is TS36.133. thus to align with existing spec, we propose to only define conditional PSCell change requirement in TS38.133. |
| Nokia | Issue 3-1: Support WF as this is according to RAN2 agreement.Issue 3-2: This would depend on what RAN2 has agreed. We support covering UE requirements for the cases supported by RAN2Issue 3-3: Would need more discussion. We do not see why Tmeasure is bounded as described. And ‘All the other terms in the above formula are similar to those in Proposal 2’ is unclear.Issue 3-4: We understand the intention of the option1, but it would still need to be discussed more detailed where the interruption would be. |
| Qualcomm | Issue 3-1: We agree to the WF.Issue 3-2: We agree to the WF.Issue 3-3: We’d like to note that as agreed in CHO, Tsearch = 0 Issue 3-4: Agreed. |
| Huawei | Issue 3-1:We can agree on option 1Issue 3-2:We can agree on option 1Issue 3-3:We can agree on option 1.The definition of Tmeasure need to be align with CHO. |
| MediaTek | **Issue 3-1: Conditional PSCell addition/release:**[MTK]: Agree on recommended WF**Issue 3-2: Where to capture conditional PSCell change**[MTK]: Agree on recommended WF**Issue 3-3: Conditional PSCell change delay:**[MTK]: Agree on recommended WF |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2000380 | Company A |
| Company B |
| xxx |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 3-1** | **Conditional PSCell addition/release***Tentative agreements:* *Requirements for conditional PSCell addition/release are not needed in this work item.**Candidate options: N/A**Recommendations for 2nd round: N/A* |
| **Issue 3-2** | **Where to capture conditional PSCell change***Tentative agreements: conditional NR PSCell change requirement will only be introduced in TS38.133**Candidate options: N/A**Recommendations for 2nd round: N/A* |
| **Issue 3-3** | **Conditional PSCell change delay***Tentative agreements:**Tconfig\_PSCell\_Conditional = TRRC\_processing + Tmeasure + TUE\_preparation + Tprocessing + T∆ + TPSCell\_ DU + 2 ms**Where* ***TRRC\_processing****: is the RRC processing to process the conditional PSCell addition command which is not larger than currently defined TRRC\_processing in TS 36.133 and TS 38.133 and begins when UE receives the RRC command for conditional PSCell change.****Tmeasure****: [is the from the end of RRC processing time to when until UE realizes the condition(s) for at least one of the PSCell candidates is/are met. For intra-frequency PSCell change, the measurement period is bounded by Tidentify\_intra\_with\_index as defined in clause 9.2.4 of TS 38.133. For inter-frequency PSCell change, the measurement period is bounded by Tidentify\_inter\_with\_index as defined in clause 9.3.4 of TS 38.133.]****TUE\_preparation****: is the UE preparation time for conditional PSCell change and starts after UE realizes the condition is met and identity of new PSCell is determined. Its value is FFS and it may include some RRC processing related to release of the existing PSCell.* ***T∆:*** *is the time for fine time tracking and acquiring full timing information of the target PSCell as in existing requirements.****Tprocessing:*** *is the SW processing time needed by UE as in existing requirements****TPSCell\_ DU:*** *is the delay uncertainty in acquiring first available PRACH occasion in the NR PSCell as in existing requirements.**Candidate options: N/A**Recommendations for 2nd round: one company has concern on the bounded Tmeasure. Corresponding definition is put in square brackets. Companies are encouraged to continue discussion.* |
| **Issue 3-4** | **Interruption during conditional PSCell change***Tentative agreements: no agreement in 1st round**Candidate options: N/A**Recommendations for 2nd round:* *Most companies agree that:* ***The interruption at conditional PSCell addition/change shall be allowed only after UE detects an event for CPAC.*** *Nokia understands the intention but would like to have more discussion. It is appreciated if Nokia can elaborate more on where the interruption would be.* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | Way forward for NR mobility enhancement | Intel |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| R4-2000380 | *to be revised* |

## Discussion on 2nd round (if applicable)

**Issue 3-3: Conditional PSCell change delay:**

* Agreement in 1st round:

*Tconfig\_PSCell\_Conditional = TRRC\_processing + Tmeasure + TUE\_preparation + Tprocessing + T∆ + TPSCell\_ DU + 2 ms*

*Where*

***TRRC\_processing****: is the RRC processing to process the conditional PSCell addition command which is not larger than currently defined TRRC\_processing in TS 36.133 and TS 38.133 and begins when UE receives the RRC command for conditional PSCell change.*

***Tmeasure****: [is the from the end of RRC processing time to when until UE realizes the condition(s) for at least one of the PSCell candidates is/are met. For intra-frequency PSCell change, the measurement period is bounded by Tidentify\_intra\_with\_index as defined in clause 9.2.4 of TS 38.133. For inter-frequency PSCell change, the measurement period is bounded by Tidentify\_inter\_with\_index as defined in clause 9.3.4 of TS 38.133.]*

***TUE\_preparation****: is the UE preparation time for conditional PSCell change and starts after UE realizes the condition is met and identity of new PSCell is determined. Its value is FFS and it may include some RRC processing related to release of the existing PSCell.*

***T∆:*** *is the time for fine time tracking and acquiring full timing information of the target PSCell as in existing requirements.*

***Tprocessing:*** *is the SW processing time needed by UE as in existing requirements*

***TPSCell\_ DU:*** *is the delay uncertainty in acquiring first available PRACH occasion in the NR PSCell as in existing requirements.*

* Recommended WF
	+ Continue discussion in the 2nd round on Tmeasure definition
	+ Continue discussion in the 2nd round on TUE\_preparation value

**Issue 3-4: Interruption during conditional PSCell change:**

* Proposals
	+ Option 1: The interruption at conditional PSCell addition/change shall be allowed only after UE detects an event for CPAC. (Huawei)
* Recommended WF
	+ Agree on option 1.

## Companies views’ collection for 2nd round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company X | **Issue 3-3: Conditional PSCell change delay:**A period for measurement is needed, similar to conditional handover, which enables UE to perform measurement on target cell and check if the conditions are met. **Issue 3-4: Interruption during conditional PSCell change:**We support option 1, i.e. not interruption is allowed if conditions are not met. |
| Ericsson | **Issue 3-3: Conditional PSCell change delay:**We should follow the corresponding approach as decided for conditional HO for Tmeasure, the UE processing will be exactly the same (internally evaluate a pseudo-event).**Issue 3-4: Interruption during conditional PSCell change:**We support the option, although network will not know the condition is met at the UE until it gets a PSCell RACH and after the interruption has occurred anyway, so the network cannot avoid the interruption by scheduling in this case. Nevertheless it would be very strange to start processing the CHO and reconfiguring RF before the condition is met (since it may easily never be met for any candidate cell, eg if the UE doesn’t move) so we support the option. |
| Qualcomm | **Issue 3-3:**The agreements for Tmeasure and TUE\_preparation in conditional PSCell change should be aligned with those in CHO. **Issue 3-4:**We agree to option 1. |
| Huawei | **Issue 3-3:**The definition of Tmeasure and TUE\_preparation for conditional PSCell change should be aligned with conditional handover.  |
| Nokia | Tmeasure seems not to include all necessary delay components. Seems only to consider cell detection delay, which is clearly not enough. We would expect the delay here is expected to be similar to what we discuss under CHO. |

## Summary on 2nd round (if applicable)

### Open issues

*Moderator tries to summarize discussion status for 2st round, list all the identified open issues and tentative agreements.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 3-3** | **Tmeasure in conditional PSCell change delay:***Tentative agreements:* *Tmeasure includes the following two parts:*1. *Delay uncertainty which is the time from when the UE successfully decodes a CPC command until a condition exists at the measurement reference point which will trigger the CPC .*
2. *Measurement event evaluation delay which begins once the delay uncertainty ends, and ends when the UE starts to execute CPC*
 |
| **Issue 3-4** | **Interruption during conditional PSCell change***Tentative agreements:* *The interruption at conditional PSCell change shall be allowed only after the measurement evaluation delay.* |

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| R4-2002226 | *agreeable* |

# Topic #4: performance part

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2001417 | Ericsson | In this contribution we discuss and analyse necessary test coverage for NR and LTE mobility enhancements (DAPS handover and conditional handover). While it would be possible to specify a large number of tests for both procedures, we propose for DAPS testing to develop fairly generic tests which can cover most different UE capabilities. For `conditional handover, we propose to verify the measurement/handover procedure and to rely on existing event triggered reporting and PSCell addition/change tests under the assumption that conditional PSCell change will behave as expected. |

## Open issues summary

**Issue 4-1: test case list for DAPS handover:**

* Proposals
	+ Option 1: (Ericsson)

|  |  |  |
| --- | --- | --- |
| Test case number | Test purpose | Description |
| 1 | Intrafrequency DAPS handover test in SA for FR1 | See R4-201417 |
| 2 | Interfrequency DAPS handover test in SA for FR1 |
| 3 | Conditional intrafrequency handover test in SA for FR1 |
| 4 | Conditional interfrequency handover test in SA for FR1 |
| 5 | Intrafrequency DAPS handover test in SA for FR2 |
| 6 | Interfrequency DAPS handover test in SA for FR2 |
| 7 | Conditional intrafrequency handover test in SA for FR2 |
| 8 | Conditional interfrequency handover test in SA for FR2 |

* Recommended WF
	+ Postpone to RAN4#94bis.

**Issue 4-2: test case list for conditional handover:**

* Proposals
	+ Option 1: capture in TS38.133 only (Intel, Ericsson)

|  |  |  |
| --- | --- | --- |
| Test case number | Test purpose | Description |
| 1 | Intrafrequency DAPS handover test | See R4-201417 |
| 2 | Interfrequency DAPS handover test |
| 3 | Conditional intrafrequency handover test |
| 4 | Conditional interfrequency handover test |

* Recommended WF
	+ Postpone to RAN4#94bis.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Issue 4-1: Baseline for further discussion in 94bisIssue 4-2: Baseline for further discussion in 94bis….Others: |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| xxxx | Company A |
| Company B |
| xxx |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 4-1** | **Test case list for DAPS handover***Tentative agreements: belongs to performance part. R4-2001417 can be used as baseline for further discussion in RAN4#94bis**Candidate options: N/A**Recommendations for 2nd round: N/A* |
| **Issue 4-2** | **Test case list for conditional handover***Tentative agreements: belongs to performance part. R4-2001417 can be used as baseline for further discussion in RAN4#94bis**Candidate options: N/A**Recommendations for 2nd round: N/A* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |