3GPP TSG-RAN WG2 Meeting #111-e draft\_R2-2008302

Online, 17th – 28th August 2020

**Agenda item: 4.1**

**Source: Huawei (offline email discussion rapporteur)**

**Title: Offline [AT111-e][302][NBIOT/eMTC R15] WUS last used cell (Huawei)**

**Document for: Report**

# 1 Introduction

This document is the report of the following e-mail discussion:

* [AT111-e][302][NBIOT/eMTC R15] WUS last used cell (Huawei)

Status:

Scope: After SA2 reply, discuss what to do in RAN2.

Intended outcome: Report in R2-2008302, and CRs (36.300, 36.304, and if needed 36.331)

Deadline: Tuesday 25 1100 UTC.

# 2 Discussion

## 2.1 Background

Documents [1] and [2] were discussed during online session with the following comments:

[R2-2007334](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007334.zip) Discussion of WUS last used cell Huawei, HiSilicon discussion Rel-15 NB\_IOTenh2-Core, LTE\_eMTC4-Core

*Proposal 1: Signal in RRCConnectionRelease message that the connection has been rejected at the eNB.*

*Proposal 2: Introduce a new indication ‘ConnectionRejection’ as a non critical extension in RRCConnectionRelease message.*

*Proposal 3: Mandate WUS capable UEs to support the new indication ‘ConnectionRejection’.*

[R2-2007566](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007566.zip) Way forward on WUS usage upon RRC connection release without S1 setup/release Qualcomm Incorporated discussion Rel-15 NB\_IOTenh2-Core

*Proposal 1: Consider solution for issue 1 does not require any RAN2 specification changes.*

*Proposal 2: If issue 2 is a rare occurrence then RAN2 should consider solution 2 as the way forward.*

*Proposal 3: If issue 2 is a frequent occurrence then RAN2 should consider introducing RRC signaling to indicate WUS UE to continue the same behaviour regarding use of WUS as if the previous access had not taken place.*

Discussion on above 2 papers:

* Huawei think there may be a long time before re-attempts if this problem occurs.
* QC thinks dedicated signalling may be needed if the problem is frequent.
* Ericsson wonders if UE will try again if it was not successful. HW thinks probably not.
* Ericsson thinks anyway this doesn’t happen frequently but in case it does the UE monitors the PO anyway so the consequence of not making any changes is acceptable.
* ZTE thinks SA2 have a potential solution from MME and we should make sure there are not 2 solutions. HW agree and think we may need to wait for SA2.
* Thales thinks we should correct this if the issue is relatively frequent, but should wait for SA2.
* QC thinks the question is how often the UE would end up being rejected in case UE thinks it should be using WUS while NW thinks otherwise.
* Nokia thinks if we do need a solution then RRC connection release is a clean solution.
* [AT111-e][302][NBIOT/eMTC R15] WUS last used cell (Huawei)

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Deadline: Tuesday 25 1100 UTC.

Since the online session, RAN2 received a LS from RAN3 [3] as follows:

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| RAN3 would like to thank RAN2 for the reply LS on system support for WUS. RAN3 understands that RAN2 identified a potential problem scenario where a UE could be unreachable for a period if it remains in the same cell, after a release occurs and the S1 connection was not established.  RAN3 has identified at least one case (i.e. MME overload for CP CIoT) where the associated condition requires receiving msg5, and therefore RAN3 confirms that the described problem scenario can occur. RAN3 does not expect the scenario to be frequent.  RAN3 has also identified several possible solutions within the RAN, i.e.:   * eNB disables WUS for a period after above event (i.e. SIB WUS indicator is not broadcast) * eNB uses WUS for all WUS-supporting UEs for a period after above event * eNB adds indicator in *RRCConnectionRelease* so that UE changes behaviour   The first two options have impact on gNB behaviour and can be realized by implementation. Besides, both carry some inefficiencies, since they either use WUS unnecessarily, or remove WUS for a period and lead to SI update twice. The inefficiency depends partly on how often the above events might happen in a network, how many UEs are involved, and also for how long the eNB should maintain the modified behaviour (which is related to the maximum periodic TAU timer).  The third option would modify only the behaviour of the affected UE and is therefore likely to be more efficient. However it is up to RAN2 to evaluate this change.  In conclusion, RAN3 confirms the scenario and thinks that at least some solutions are available as described. Since the identified solutions have no stage 3 impacts on RAN3 specifications, RAN3 would like to suggest that a final decision on this matter can be made by RAN2. |

SA2 has also just agreed on a reply LS [4] as follows:

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| SA2 would like to thank RAN2 for the reply LS on system support for WUS (S2-2005090/R2-2005985). SA2 acknowledges the RAN2 identified potential problem scenario where a UE could be unreachable for a period if it remains in the same cell, after a release occurs and the S1 connection was not established.  SA2 discussed the scenario described by RAN2 and as the core network is never contacted the core network cannot be aware of the scenario.  SA2 has discussed the option of the MME being configured with paging strategies to allow the first page in the last known ECGI or TA to be provided with the last known ECGI, and paging retransmissions to not be provided with the last known ECGI for subsequent paging and WUS being broadcast when the last known ECGI is not provided. This option may resolve the UE unreachable issue mentioned in RAN2 liaison but will have impacts on paging strategies a network can use and/or undesirable impact on the population of WUS capable UEs in the TA.  As a result SA2 asks RAN2 and RAN3 to address the scenario without impact to the core network. If any alignment is needed in SA2, then please let SA2 know, so SA2 can take any feedback into account. |

Based on RAN3 and SA2 replies, the solution is up to RAN2.

## 2.2 Which solution to select in RAN2

Three potential solutions has been proposed in RAN2 and in the RAN3 reply LS:

1. eNB disables WUS for a period after above event (i.e. SIB WUS indicator is not broadcast)
2. eNB uses WUS for all WUS-supporting UEs for a period after above event
3. eNB adds indicator in *RRCConnectionRelease* so that UE changes behaviour

Companies are invited to provide comments on the three solutions, including what is the expected impact (if any) on the RAN2 specification(s), and indicate their preference.

**Company views**

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| **Company** | **Preference (a, b or c)** | **Comments** |
| Qualcomm | B | Solution A is strongly not preferred as it will cause all UEs in the cell to re-read SIBs.  Solution B is preferred as it avoids ASN.1 change (especially to R15). We think the issue is quite rare and could be handled by network implementation.  If there is strong support then Solution C is acceptable too but the UE action upon receiving the new indicator needs to be discussed and not have impact on functionality other than (G)WUS. |
| Ericsson | B | Agree with Qualcomm regarding the comments on solutions A and B. If there is really a need/strong support for C, we think there is an alternative with no ASN.1 impact. For example, when the UE is released to idle with (*extended)WaitTime* configured in the *RRCConnectionRelease* message, one can specify that UE does not consider that cell as the last cell where RRC connection was established successfully since it would implicitly indicate that there was a problem with S1 connection even though RRC connection was established successfully. |
| Lenovo | C | Solution A is not supported because of the same view as Qualcomm.  Solution B is not supported because it will have visible impact to other UE.  Solution C is preferable, but the indication is better to be interpreted as “the current serving cell is not updated as the last used cell in CN node”, this interpretation is simple and directly give the final result not the cause, we think the CN Connection Reject is just one case leading to last used cell updating failure, maybe there are some other cases based on MME overload. So we think the interpretation of indication should be further discussed. |
| Sequans | B for Rel-15  C For Rel-16+ | We don’t have to agree the same solution for all releases. We agree option A is too problematic due to SIB updates. Solution B is good for Rel-15 to avoid NBC ASN.1 change. Solution C can work quite nicely from Rel-16 onwards. We are OK to discuss further an implicit indication as suggested by Ericsson, though the explicit one seems simpler. |
| Huawei, HiSilicon | C | Solution A is not acceptable for the same reason as indicated by Qualcomm and Ericsson.  Solution B is not preferred as even though the event may be rare (maybe once a month or every two months) then WUS may be used in all cells for a very long time (maximum T3412 timer = 32 \* 320 hours = 10,240 hours or 426 days) which will completely disabled the last used cell solution.  Solution C is preferred and we would like a generic solution.  W,r,t Qualcomm’s comment, we agree there should not be no impact on functionality other than WUS, but this can be solved by the description of the new parameter, i.e. specify the handling only for the case UE supports (G)WUS.  W.r.t Ericsson’s proposal, we would be OK if MME overload for the CP solution was the only case, but this has not stated in the RAN3 LS. E.g. in 5GC, overload is slice based and the UE only indicates the slices it supports in RRCConnectionSetupComplete so we think an explicit indication is safer.  W.r.t Sequans’s comment, we assume that the ASN.1 change will be a non-critical extension and be backward compatible. The non-backward compatibility is related to the feature itself and this is already the case with the introduction of the last cell solution. About having different solutions in rel-15 and rel-16, we do not think it is feasible as the NW does not know the release of the UE. |
| ZTE | All the RAN solutions are infeasible  prefer MME scheme | We fully agree with the above concern for solution A and disagree it.  After further thinking, we realize the cases for inconsistent understanding on last cell between UE and network are not only 1, but at least 2:   * Case 1): S1 connection fail to setup in new cell B due to MME overload while UE is normally released. * Case 2): S1 connection is setup successfully in new cell B while UE is not normally released due to missing of *RRCConnectionRelease* message.   Obviously, Solution C can only deal with the case 1) but cannot deal with the case 2). So it’s infeasible.  Solution B may be better than C) but also infeasible with the following reasons: eNB can be clear about occurrence of Case 1) and also know occurrence of Case 2) if fast RRC release is not used. But if fast RRC release is applied, it’s impossible for eNB to aware of Case 2). Moreover, during the so-called “a period”, if the UE has not performed a successful Uu and S1 connection establishment, the last cell inconsistence issue would still exist after this period. So we say solution B can only solve the issue with a certain probability. The longer the period, the higher the probability. Finally, as mentioned above by other companies, solution B also cause false wakeup impacts (Thanks HW for a brief calculation) on other UEs.  We know SA2 has discussed the following MME scheme and notice SA2 has confirmed its feasibility as following:  *SA2 has discussed the option of the MME being configured with paging strategies to allow the first page in the last known ECGI or TA to be provided with the last known ECGI, and paging retransmissions to not be provided with the last known ECGI for subsequent paging and WUS being broadcast when the last known ECGI is not provided. This option may resolve the UE unreachable issue mentioned in RAN2 liaison but will have impacts on paging strategies a network can use and/or undesirable impact on the population of WUS capable UEs in the TA*  From RAN2 perspective, we understand such MME scheme can deal with both Case 1) and Case 2) mentioned above.  We can also understand the shortcoming of this MME scheme, e.g., undesirable (false wakeup) impact on the population of WUS capable UEs in the TA, but we think such bad impacts would be less than that of Solution B. Generally to say, when the corner case of last cell inconsistence happens, the false wakeup impacts of MME scheme are caused by paging for only one problematic UE and in a TA range. While the false wakeup impacts of solution B are caused by the pagings for all the UEs during “a period” and in the eNB range for each paging. If “a period” is kind of long, it’s easy to understand the false wakeup impacts of solution B would be larger than that of MME scheme.  Based on all above considerations, we think all the RAN solutions are infeasible. So we suggest to feedback to SA2 that RAN2 has identified another case that RRCConnectionRelease message is lost and then RAN2 cannot deal with the last cell inconsistence issue. RAN2 suggest SA2 to re-consider the MME scheme (e.g. last cell info is not carried in S1AP PAGING retransmission and WUS is broadcast in the TA area in this case). On the same time, RAN2 can just agree the 36.300 and 36.304 CRs. |
| Nokia | C | Solution A is not desired as system information change also impacts all the UE.  Out of B and C ,C is clear solution for the problem without relying on network implementation. Solution B also requires some network implementation to enable different behavior for the duration of specific situation.  The indication in RRC Connection Release should be used only to indicate that UE should not consider this cell as last connected cell for WUS reception. |

Conclusion:

No company supports solution A.

One company indicates that none of the solution works and wants to revert to the MME solution that was retained by SA2 due the impact on the MME paging strategy. Rapporteur thinks that if the UE goes to RRC\_IDLE on its own (e.g. based on data inactivity monitoring) then the UE is supposed to initiate NAS recovery and there is no mismatch issue.

Two companies prefer solution B but would accept solution C if there is strong support.

One company prefers solution B for Rel-15 and solution C for Rel-16. One company commented that it is not feasible to have different solution for Rel-15 and Rel-16 as the eNB may not know the release of the UE.

Three companies prefer option C.

**Proposal 1**: RAN2 to implement solution C, indication in RRCConnectionrelease

All companies indicated for solution C that it should impact only WUS capable UE. One company indicates that the indication could be implicit and there may be no need for an ASN.1 change.

**Proposal 2**: RAN2 to discuss how to introduce solution C.

**Other comments.**

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| **Company** | **Comments** |
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Conclusion:

## 2.3 Round 2 – How to implement solution C

Potential solutions to implement solution C:

1. Explicit indication introduced a late Rel-15 NCE
2. Explicit indication introduced a normal Rel-15 NCE, which means a Rel-16 NBC
3. Implicit indication, e.g. based on presence of extendedWaitTime-CPdata
4. Other ?

Companies are invited to provide comments on how to implement solution C and whether it will cover all cases and applies the same way to NB-IoT and eMTC ), and indicate their preference.

**Company views**

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| **Company** | **Preference (a, b, c or other)** | **Comments** |
| Huawei, HiSilicon | b) | Option b) is similar but simpler ASN.1 wise than option a). As we already have agreed NBC in RRCConnectionRelease in both eMTC/LTE and NB-IoT, we see no problem with the NBC  Option c) can work for NB-IoT if we base the behaviour on presence of any of extendedWaitTime-CPdata/ extendedWaitTime timer in RRCConnectionRelease as one or the other timer is signalled in case of overload. As the UE cannot know based on the timer only if the S1/NG connection has been established or not, the UE will have to disable WUS until it accesses successfully again. In this way, basing the determination on the presence of the timer is less efficient as an explicit indication that the S1/NG connection was not established.  Option c) would work for eMTC connected to 5GC as in case of overload the waitTime time will be included. However, option c) does not work for eMTC connected to EPC as the extendedWaitTime timer is only applicable to delay tolerant UE.  for option b), to avoid impact on non-WUS capable UE, we could introduce the indication as OPTIONAL need OP and specify the behaviour in 36.304, e.g:  Paging with Wake Up Signal is only used in the cell in which the UE most recently entered RRC\_IDLE upon reception of *RRCConnectionRelease* not including *connectionRejection*  /*RRCEarlyDataComplete* from the eNB. |
| Qualcomm |  | We prefer to have an explicit indication and not overload an existing parameter to signal (ng)eNB was not able to establish/resume and then release/suspend RAN-CN logical connection for this UE.  Because the (ng-)eNB does not have UE capability (no RAN-CN logical connection was established) then (ng-)eNB may not know whether UE is Release 16 compliant or not then it cannot know whether to use Release 16 construct of *RRCConnectionRelease* message or use Release 15 construct. Ofcource, a Release 16 compliant UE would work with both constructs but a Release 15 complaint UE would not hence this UE would still suffer from the issue this new indicator is intended for.  Therefore, we propose the same ASN.1 construct in R15 and R16. |
| ZTE |  | We are fine to implement solution C. No strong view on option a) or b).  For option c), we agree with HW that it does not work for all cases. The cases for *(extended)WaitTime* configured in the *RRCConnectionRelease* message are not only CN overload. It's also possible RAN overload. We think option c) can only be used for the case of CN overload but may be not suitable for the case of RAN overload.  In such RAN overload case, we assume S1/NG interface has already been successfully established. Then it's not suitable to let UE assume there was a problem with S1 connection when receiving the *(extended)WaitTime*. In other word, in this case, the current cell can be seen as last serving cell and WUS last serving cell scheme still can be used. |

Conclusion:

One company prefers option b) and thinks option c) does mot work for all cases.

One company prefers to have an explicit indication and not overload an existing parameter, i.e. option a) or b).

**Proposal 3**: RAN2 to introduce an explicit indication as a normal Rel-15 NCE in RRCConnectionRelease message.

## 2.4 RAN2 CRs

It is proposed to discuss the CRs in a second phase after RAN2 has agreed the solution to go for.

The RAN2 CRs postponed at last meeting are available in [6], [7], [8] and [9].

Note that SA2 has also agreed CRs introducing WUS support for 5GC [10][11] and CRs updating WUS in EPC according to RAN3 feedback. SA2 is sending a LS to inform RAN2 and RAN3 [5].

# 3 Summary

**First round summary:**

**Proposal 1**: RAN2 to implement solution C, indication in RRCConnectionRelease

**Proposal 2**: RAN2 to discuss how to introduce solution C.

**Second round summary:**

**Proposal 3**: RAN2 to introduce an explicit indication as a normal Rel-15 NCE in RRCConnectionRelease message.

# 4 List of referenced documents

1. [R2-2007334](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007334.zip" \o "https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007334.zip) Discussion of WUS last used cell Huawei, HiSilicon

1. [R2-2007566](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007566.zip" \o "https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007566.zip) Way forward on WUS usage upon RRC connection release without S1 setup/release Qualcomm Incorporated
2. [R2-2008457](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Inbox/R2-2008457.zip) Reply LS on system support for WUS (R3-205652; contact: Qualcomm) RAN3

1. [S2-2006478](https://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_140e_Electronic/INBOX/S2-2006478.zip) LS on system support for WUS (S2-2005090/R2-2005985) SA2

1. [S2-2005078](https://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_140e_Electronic/Docs/S2-2005078.zi) [DRAFT] Reply LS on assistance indication for WUS SA2

1. [R2-2007330](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007330.zip" \o "https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007330.zip) System support for Wake Up Signal Huawei, HiSilicon CR Rel-15 36.300 15.10.0 1264 3 F NB\_IOTenh2-Core, LTE\_eMTC4-Core

1. [R2-2007331](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007331.zip" \o "https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007331.zip) System support for Wake Up Signal Huawei, HiSilicon CR Rel-16 36.300 16.2.0 1265 2 F NB\_IOTenh2-Core, LTE\_eMTC4-Core

1. [R2-2007332](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007332.zip" \o "https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007332.zip) System support for Wake Up Signal Huawei, HiSilicon CR Rel-15 36.304 15.6.0 0795 2 F NB\_IOTenh2-Core, LTE\_eMTC4-Core

1. [R2-2007333](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007333.zip" \o "https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007333.zip) System support for Wake Up Signal Huawei, HiSilicon CR Rel-16 36.304 16.1.0 0796 2 F NB\_IOTenh2-Core, LTE\_eMTC4-Core

1. [S2-2006209](https://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_140e_Electronic/INBOX/S2-2006209.zip) WUS system support for 5GC Qualcomm Incorporated CR Rel-16 23.501 2407 1 F

1. [S2-2005077](https://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_140e_Electronic/Docs/S2-2005077.zip) WUS system support for 5GC Qualcomm Incorporated CR Rel-16 23.502 2345 - F

# 5 Participants

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| --- | --- | --- |
| Qualcomm | Mungal | mdhanda@qti.qualcomm.com |
| Ericsson | Emre A. Yavuz | emre.yavuz@ericsson.com |
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