**3GPP TSG-RAN WG2 Meeting #130 R2-2504738**

Malta, 19th – 23rd May 2025

**Agenda item: 8.4.2**

**Source: Huawei/HiSilicon**

**Title: Summary of [AT130][204][LPWUS] Proposals on whether/how to enable/disable LP-WUS, e.g. by RRC/NAS (Huawei)**

**WID: NR\_LPWUS-Core**

**Document for: Discussion and Decision**

# Introduction

This document aims to collect views from companies for the following offline discussion:

* [AT130][204][LPWUS] Proposals on whether/how to enable/disable LP-WUS, e.g. by RRC/NAS (Huawei)

Intended outcome: Summary with proposals in R2-2504738.

Deadline: before Thursday CB

Please provide your input before 10am on Thursday.

Please provide your contact information when responding.

|  |  |
| --- | --- |
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# Discussion

RAN2 had an initial discussion on enabling/disabling of LP-WUS based on the proposals from contribution R2-2503809 and R2-2503900. Below is the related excerpt from the chairman notes:

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| --- |
| *[RRC-12, whether/how to enable/disable LP-WUS, e.g. by RRC/NAS]*  R2-2503809 Remaining issues of LP-WUS in RRC\_IDLE/INACTIVE Apple discussion Rel-19 NR\_LPWUS-Core  *Proposal 2: For UE in RRC\_IDLE state to enable/disable the LP-WUS feature, there is no need to introduce additional UE dedicated signaling for control, i.e. UE level control can be performed by means of the LP-WUS group ID allocated by CN.*  *Proposal 3: For UE in RRC\_INACTIVE state to enable/disable the LP-WUS feature, network can enable/disable the LP-WUS feature within RNA through RRCRelease message.*  R2-2503900 Further discussion on the LP-WUS in RRC\_IDLE/INACTIVE mode Huawei, HiSilicon discussion Rel-19  *Proposal 2: (RRC-12) The CN indicates whether LP-WUS capable UE(s) is/are allowed to use the LP-WUS functionality by NAS signaling: the absence of indication means UE is allowed to use LP-WUS functionality, and presence of indication to disable means UE is not allowed to use LP-WUS functionality.*  *Proposal 2a: If above proposal is agreed, send LS to SA2/CT1/RAN3 to inform the agreement and to update the signalling between CN and RAN.*  Discussion  - CATT think there is other way, e.g., UE can decide whether LPWUS is enabled or disabled based on latency.  - ZTE think for CN based way it is not up to R2.  - Ericsson think it can base on CN assigned subgrouping. Ericsson think if we introduce disable/enable signalling in RRCRelease it introduce impact to other WGs.  - Docomo think it is based on gNB implementation, and support RRC based indication.  - Sony wonders what is the requirement to UE. |

CATT commented during online that there is another way, i.e., UE can decide whether LPWUS is enabled or disabled based on latency. Their proposals are given below:

|  |
| --- |
| **Proposal 1: (RRC-12) Enabling/disabling LP-WUS monitoring in IDLE/INACTIVE per UE is supported.**  **Proposal 2: (RRC-12) RAN2 consider UE to determine whether to enable/disable LP-WUS monitoring in IDLE/INACTIVE based on latency requirement (i.e., i-DRX cycle of the UE).** |

We can first discuss whether to support enabling/disabling LP-WUS per UE, and then discuss how to support.

## Whether to support enabling/disabling LP-WUS in IDLE/INACTIVE per UE?

From CATT’s proposal: “**(RRC-12) Enabling/disabling LP-WUS monitoring in IDLE/INACTIVE per UE is supported.**”

#### Q1. Do companies agree to support enabling/disabling LP-WUS monitoring in IDLE/INACTIVE per UE?

|  |  |  |
| --- | --- | --- |
| Company | Answer (Yes or No) | Comments |
| LGE | Yes | LP-WUS monitoring is not suitable for UEs with high paging probability or UEs with emergency PDU session. |
| Ericsson | yes | The paging performance is an important KPI in the network, and when the paging performance for a specific UE is significantly impaired the NW should be able to disable LP-WUS for that UE. This enabling/disabling is semi-static, i.e. it can change again after registration, but it might also be kept unchanged until the UE registers with another NW. We think that this use case is best supported at the NAS level, i.e. centrally controlled from the CN where paging KPI info may be available.  We also think that the use case that CATT has brought up makes sense, i.e. when the gNB releases the UE to RRC\_INACTIVE with a short DRX cycle (e.g. 320 ms) or when the gNB releases the UE to RRC\_IDLE and the UE has a UE specific DRX cycle configured shorter than the *defaultPaging* cycle in SIB1 then it might make sense to have the possibility to disable LP-WUS in that UE, i.e. LP-WUS introduces further latency. But the gNB is not aware of the UE specific DRX cycle of the UE in RRC\_CONNECTED, i.e. this is not part of the UE capabilities, and this DRX cycle is only conveyed in the PAGING message from CN to RAN for CM-IDLE paging. |
| NTT docomo | Yes | From the operator’s perspective the paging performance should not be degraded especially in case of emergency call back. |
| NEC | Yes | We have the following reasons to support dedicated enable/disable:  1. Paging false alarm  When large amount of UEs are monitoring LP-WUS, once one UE is paged, unnecessary LP-WUS reception to other UEs is increased. Therefore if NW can control part of UEs monitor LP-WUS and other part of UEs do not monitor LP-WUS, it can provide flexibility and avoid potential serious paging false alarm.  2. Latency requirement  For LP-WUS monitoring UE, the paging delay is increased compared with normal paging monitoring UE. If NW want one specific LP-WUS capable UE not to enter LP-WUS monitoring considering latency, the NW can send this dedicated enable/disable indication to this UE, which avoids latency issue.  3. Power consumption  If the transition between MR and LR is frequent for some specific UEs, the power saving could be overkilled. For example, if the paging probability is relatively high, the UE better not to monitor LP-WUS even though this UE supports LP-WUS feature.  Therefore, the dedicated signalling for enable/disable should be supported. |
| Interdigital | Yes |  |
| Huawei/HiSilicon | Yes | To reduce false paging probability, NW can decide whether a LP-WUS capable UE is allowed to use the LP-WUS functionality based on the conditions in the network. |
| Nokia | No | Broadcast signaling is sufficient. It has been agreed to leave the LP-WUS monitoring up to implementation i.e. the UE supporting LP-WUS is not mandated to monitor LP-WUS. So dedicated signaling is not needed since UE can anyway choose not to monitor LP-WUS. |
| ZTE | Yes | LP-WUS may lead large delay, and is not beneficial for delay critical service. NW should be able to enable/disable LP-WUS monitoring for UE in RRC\_IDLE/RRC\_INACTIVE state based on service characteristics. |
| OPPO | Yes | In some case, e.g., emergency call, it is better to disable the LP-WUS to reduce the latency. |
| Xiaomi | See comments | Some companies mentioned emergency case.  However, currently SA2 was rethinking about this and considering removing the emergency PDU session restrictions for Paging Early Indication. If the same principle is reused for LP-WUS, then currently, we do not need to disable the LP-WUS for emergency calls.  At least the requirement to disable LP-WUS is not clear. |
| Samsung | Yes | Support per UE group as in Apple’s proposal 2 for both Idle/Inactive |
| CATT | Yes | LP-WUS monitoring is not suitable for UEs with short paging DRX cycle. Regarding the existing agreements on wake-up delay in RAN1, 900ms additional paging latency may be introduced when UE performs LP-WUS monitoring. However, paging cycle the UE monitors (i.e., i-DRX cycle of the UE) maybe 320ms. The additional paging latency introduced by LP-WUS is larger than i-DRX cycle of the UE in this case. Considering paging DRX cycles vary among different UEs, it is useful to enable/disable LP-WUS monitoring in IDLE/INACTIVE per UE according to latency requirements per UE. |
| Sony | Yes |  |
| vivo | Yes | The Network could enable/disable the LP-WUS per UE based on the UE characteristic. |
| Apple | Yes | For IDLE UE, we can rely on CN allocated group ID to achieve the UE dedicated control.  (Note: If network doesnot provide the *lpSubgroupsNumForUEID* parameter in SIB1 of one cell, UEID based group ID will be disabled in that cell, and only the UE configured with CN allocated group ID will monitor the LP-WUS.)  For INACTIVE UE, we are open to discuss whether to support the RRC based control. |
| Lenovo | No | We have similar view as Nokia. We do not see the need to have additional dedicated signalling since broadcast signal is sufficient. Additionally, since paging is not a latency-sensitive use case, we do not see the need to limit the use of this feature. And with 32 subgroups, the false alarm rate is also significantly lower than PEI or legacy paging.  During IDLE/ INACTIVE, we also do not understand why UEs need to be differentiated by service characteristics and hence, there is no real motivation to specify enabling/ disabling signaling for LP-WUS when only one meeting remains. |
| Tejas Networks | No | With LP-WUS supporting higher number of subgroups, the issue of false alarms is already handled. No need to enable/disable UEs with dedicated signalling. |

**Summary:**.

1. 17 companies responded. 13 companies agree to support enabling/disabling LP-WUS monitoring in IDLE/INACTIVE per UE. However, the reasons given in comments for supporting are different and are listed below:
   1. To minimize false paging probability OR improve paging performance
   2. To support delay critical services
   3. To support emergency call back
2. 3 companies commented responded No.

**Rapporteur’s input:** Considering the majority, rapporteur proposes the following.

**Proposal 1 (13/17): Support enabling/disabling LP-WUS monitoring in IDLE/INACTVE per UE.**

## Whether to have a unified solution for IDLE and INACTIVE?

Based on Apple’s proposals, rapporteur understands that enabling/disabling of LP-WUS feature is done different for IDLE and INACTIVE. Hence, would like to get companies input on whether a unified solution for both states is preferred or not.

#### Q2. Do companies prefer a unified solution to enable/disable LP-WUS per UE for IDLE and INACTIVE?

|  |  |  |
| --- | --- | --- |
| Company | Answer (Yes or No) | Comments |
| LGE | Yes |  |
| Ericsson | Yes | We do not see the need to have a different way to enable/disable LP-WUS in RRC\_INACTIVE and RRC\_IDLE.  We also think that the NAS method and *RRCRelease* method can co-exist, i.e. each method addresses a different use case, i.e. paging performance and latency. And the enable/disable status is retained when the UE goes into and out of connected mode for the NAS method, but it is reset for the *RRCRelease* method. |
| NTT docomo | Yes |  |
| NEC | Yes | We prefer a unified solution for both RRC\_IDLE and RRC\_INACTIVE no matter we go for CN solution or RAN solution.  In fact, CN-based subgroup ID is optional, we can not reply on this to control enable/disable feature. |
| Interdigital | Yes |  |
| Huawei/HiSilicon | Yes |  |
| Nokia | No | Broadcast signaling is sufficient. |
| ZTE | Yes |  |
| OPPO | Yes |  |
| Xiaomi | Yes | If so, then a unified solution is preferred. |
| Samsung | Yes |  |
| CATT | Yes | Prefer to have a unified and simple solution. |
| Sony | Maybe | Agree with Ericsson and NEC, but maybe unified is a bit misleading since different methods are needed for Idle and Inactive. |
| vivo | Yes | A unified solution is more simple. Both CN and gNB have the UE context for UE in RRC\_INACTIVE, thus it is reasonable to enable/disable LP-WUS per UE by gNB/CN, considering a unified solution for RRC\_INACTIVE and RRC\_IDLE should be applied, we think CN is a better choice. |
| Apple | Yes | We are fine to support the unified solution. |
| Lenovo | See comment | Broadcast signaling is sufficient. |
| Tejas Networks | No | No need for dedicated signalling |

**Summary:** The responses to this question are in-line with the responses to Q1.

**Rapporteur’s input:** Considering the majority view, rapporteur proposes the following.

**Proposal 2 (13/17): A unified solution is preferred to enable/disable LP-WUS per UE for IDLE and INACTIVE.**

## How to support enabling/disabling LP-WUS in IDLE/INACTIVE per UE?

Following are the different options.

|  |  |
| --- | --- |
| Option 1 | *NW can enable/disable LP-WUS monitoring per UE via dedicated RRC message, e.g. RRCRelease message* |
| Option 2 | *The CN indicates whether LP-WUS capable UE(s) is/are allowed to use the LP-WUS functionality by NAS signaling: the absence of indication means UE is allowed to use LP-WUS functionality, and presence of indication to disable means UE is not allowed to use LP-WUS functionality.* |
| Option 3 | *RAN2 consider UE to determine whether to enable/disable LP-WUS monitoring in IDLE/INACTIVE based on latency requirement (i.e., i-DRX cycle of the UE).* |

#### Q3. Which option from the above do you support to enable/disable LP-WUS in IDLE/INACTIVE per UE?

|  |  |  |
| --- | --- | --- |
| Company | Answer | Comments |
| LGE | Option 2 | CN has more information than RAN on UE characteristics, such as paging probability, and traffic. |
| Ericsson | Option 2, see also comment | But we are also open to support **in addition** enabling/disabling in RRC\_INACTIVE and RRC\_IDLE via *RRCRelease.*  We need more time to check what information in RRC\_CONNECTED mode can be used to disable LP-WUS in RRC\_IDLE. We want to prevent complex/long discussions about power saving vs latency, and whether there is UE preference, etc, etc. We should keep this method simple. |
| NTT docomo | Option1 (and Option2) | RRC\_IDLE and INACTIVE handling is based on the gNB implementation. For the case of Emergency call back gNB may be implemented to keep RRC CONNECTED. CN does not understand the gNB implementation. So Option1 is suitable for the gNB implementation. But we are fine with Option2 for the specific CN implementation **in addition** Option1. |
| NEC | Opt-1 and/or Opt-2 | Dedicated enable/disable is useful as we mentioned in the section above no matter we go for opt-1 and/or opt-2.  For opt-3, there is not only latency issue but also other facts would impact whether the LP-WUS should be enabled or not, so it is not enough.  Furthermore, both opt-1 and opt-2 has minor impact on other WGs.  For opt-1, the NG-RAN needs to inform CN of LP-WUS is enabled/disabled (for CN paging).  For opt-2, the CN needs to inform NG-RAN of LP-WUS is enabled/disabled (for RAN paging). |
| Interdigital | Option 1 and Option 2 | We prefer support both options rather than down-selecting one of the options. AS-based solution (option 1) is focused on (de-)activation LP-WUS monitoring dynamically based on the pending/upcoming DL traffic which is performed by gNB.  Also, NAS-based solution (option 2) is focused on (de-)activation LP-WUS monitoring semi-statically based on UE capability which is performed by CN.  In our view, each option suitable for each different scenario and specified in different layers, hence we prefer support both options. There is no problem if NW supports both options and UE follows NW’s decision. How to trigger one of the options is up to NW implementation. |
| Huawei/HiSilicon | Option 2 | Having both options to solve the same problem is not preferred.  With Option 1:   1. The impact to other working groups is not clear and we think the impact is more than Option 2. For IDLE paging, changes between RAN and CN are needed; and for INACTIVE, other RAN nodes need to know that LP-WUS is disabled. 2. How to enable the functionality again after RRCRelease? |
| Nokia |  | In case RAN2 agrees to have dedicated signaling support for LP-WUS then only option 1 can be considered in RAN2. Option 3 requires NAS signaling which cannot be agreed in RAN2. RAN node knows better than CN whether and how to configure LP-WUS or not for some UE. For example RAN node may know offset required between LP-WUS and PO which is not known by CN. |
| ZTE | Option 1 | Since LP-WUS is sent from gNB to UE, NAS signalling method will impact SA2, RAN3 and RAN2 specification, it’s complicated and out of RAN2 scope. So, Option 2 is not prefer.  WE prefer a per UE method for enabling/disabling LP-WUS monitoring in IDLE/INACTIVE, to avoid LP\_WUS impact on delay critical service, so option 3 is not prefer. |
| OPPO | Option1 and Option2 | We support both Option1 and Option 2. Option1 can disable/enable the LP-WUS based on gNB requirement better, for example, considering the emergency call or other pending data. Option2 can reflect the CN requirement better. When both solutions work together, the new received indication of disable/enable will override the indication received before. |
| Xiaomi | See comments | Whether enabling/disabling LP-WUS for UE by dedicated RRC signalling was discussed a lot in last meeting and it is still FFS. At least supporting dedicated LP-WUS monitoring (de-)activation per UE via RRC release message was not liked by companies as the gNB may not know the feature status/activities of UE while (de-)activation per UE. Hence, option1 is not preferred.  And option1 do not work for UE reselection to another cell.  However, option2 is in the scope of CT1 and not in the scope of RAN2.  Option3 can be considered. |
| Samsung | See comments | We do not support option 1, 2, and 3.  We support the below proposal from Apple with Idle/Inactive UE:  *For UE in RRC\_IDLE/Inactive state to enable/disable the LP-WUS feature, there is no need to introduce additional UE dedicated signaling for control, i.e. UE level control can be performed by means of the LP-WUS group ID allocated by CN.* |
| CATT | Option 3 | As mentioned in Q1, LP-WUS monitoring is not suitable for UEs with short paging DRX cycle. Paging DRX cycle of a UE is determined by the shortest of the UE specific DRX value configured by RRC (if any). The UE specific DRX value configured by upper layers (if any), and a default DRX value broadcast in system information. Therefore, it is possible for the UE to decide whether to enable/disable LP-WUS monitoring without additional dedicated indication from NW via NAS or RRC.  We also think Option 1 brings impact on RAN3, e.g. RAN node needs to notify CN whether to enable/disable LP-WUS monitoring for the UE when it releases the UE, and CN paging message or RAN paging message between NW nodes need to indicate whether to enable/disable LP-WUS monitoring for the UE.  Moreover, LP-WUS can reduce paging false alarm rate with subgrouping mechanism. The CN can assign suitable CN assigned subgrouping ID to a UE based on its own strategy, e.g. UE paging probability, UE type and so on. For example, the CN can group UEs with high paging probability into the same CN assigned subgrouping ID to reduce paging false alarm rate. We don’t see a need to introduce additional dedicated mechanism for UEs with different paging probabilities. |
| Sony | Option 1/Option 2 | For RRC-Inactive mode, the release procedure and knowledge of the situation in serving cell is only know to the gNB, while the CN has the overview situation of Idle mode UEs.  An alternative option is the combination i.e., support option 2 for RRC-Idle, and option 1 for RRC-Inactive. |
| vivo | Option 2 | Agree with LGE. |
| Apple | Comment | Considering the majority view is to have the unified solution, we can just rely on the CN allocated group ID to achieve the UE dedicated control for both IDLE/INACTIVE UE, and any new indication is not needed.  (Note: If network doesnot provide the *lpSubgroupsNumForUEID* parameter in SIB1 of one cell, UEID based group ID will be disabled in that cell, and only the UE configured with CN allocated group ID will monitor the LP-WUS.) |
| Lenovo | See comments | We do not support any options, but if dedicated control is agreed – then we prefer Apple’s proposal:  *For UE in RRC\_IDLE/Inactive state to enable/disable the LP-WUS feature, there is no need to introduce additional UE dedicated signaling for control, i.e. UE level control can be performed by means of the LP-WUS group ID allocated by CN.* |
| Tejas Networks | See comments | We prefer option proposed by Apple but that decision cannot be made at RAN2. |

**Summary:**

Based on the responses, it’s clear that there is no majority for any option as shown below:

1. Option 1: ZTE
2. Option 2: LG, Ericsson, HW, Vivo
3. Option 1 and Option 2: DoCoMo, NEC, InterDigital, Oppo
4. Option 3: Xiaomi, CATT
5. Proposal from Apple: Apple, Samsung, Lenovo, Tejas

**Rapporteur’s input:**

1. **There is no clear majority for any option. As Option 3 got the least support, rapporteur suggests to preclude Option 3 to make progress.**
2. **For both NAS and RRC based solution, there are some questions on the impact to CT1/RAN3 for IDLE and INACTIVE. Rapporteur requests proponents to present the details of how to enable and disable LP-WUS and the impacts to other working groups for both IDLE and INACTIVE in their contribution to the next meeting OR in the post-meeting email discussion if any.**

**Proposal 3: FFS how to enable/disable LP-WUS per UE for IDLE and INACTIVE. Following options can be considered: 1) NAS signalling 2) RRC signalling 3) No spec changes (i.e., if no convergence on NAS or RRC signalling)**

# Conclusions

Based on the inputs from companies, the following proposals are made:

**Proposal 1 (13/17): Support enabling/disabling LP-WUS monitoring in IDLE/INACTVE per UE.**

**Proposal 2 (13/17): A unified solution is preferred to enable/disable LP-WUS monitoring in IDLE/INACTIVE per UE.**

**Proposal 3: FFS how to enable/disable LP-WUS per UE for IDLE and INACTIVE. Following options can be considered: 1) NAS signalling 2) RRC signalling 3) No spec changes (i.e., if no convergence on NAS or RRC signalling)**

# References

1. R2-2503809 Remaining issues of LP-WUS in RRC\_IDLE/INACTIVE, Apple
2. R2-2503900 Further discussion on the LP-WUS in RRC\_IDLE/INACTIVE mode, Huawei/HiSilicon
3. R2-2503659 Remaining issues on LP-WUS in IDLE and INACTIVE, CATT.