3GPP TSG-RAN WG2 #114e Tdoc R2-20xxxxx

Electronic meeting, May 19th – May 27th, 2021

Agenda Item: 9.1.3

Source: Ericsson

Title: Summary of NB-IoT AI 9.1.3 carrier selection based on coverage level

Document for: Discussion, Decision

# 1 Introduction

The below papers have been submitted in the AI 9.1.3. The paper provides the summary of the submitted papers.

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| --- | --- | --- | --- |
| [1] | [R2-2106380](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_114-e/Docs/R2-2106380.zip) | Network configuration for paging carrier selection | Nokia Solutions & Networks (I) |
| [2] | [R2-2106198](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_114-e/Docs/R2-2106198.zip) | Carrier selection enhancement | MediaTek Inc. |
| [3] | [R2-2105317](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_114-e/Docs/R2-2105317.zip) | Further discussion on CEL-based paging carrier selection  | ZTE Corporation, Sanechips |
| [4] | [R2-2105544](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_114-e/Docs/R2-2105544.zip) | Further discussion on enhanced paging carrier selection and NPRACH carrier selection | Spreadtrum Communications |
| [5] | [R2-2105658](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_114-e/Docs/R2-2105658.zip) | Clarification on Paging carrier selection | Huawei, HiSilicon |
| [6] | [R2-2105659](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_114-e/Docs/R2-2105659.zip) | Guildelines for the design of coverage based paging carrier selection | Huawei, HiSilicon |
| [7] | [R2-2105642](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_114-e/Docs/R2-2105642.zip) | Simplified Static solution | THALES |
| [8] | [R2-2106076](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_114-e/Docs/R2-2106076.zip) | Analysis of Rmax based solution and carrier-based solution | Ericsson |
| [9] | [R2-2105919](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_114-e/Docs/R2-2105919.zip) | Considerations on the two paging carrier selection schemes | Qualcomm Incorporated |
| [10] | [R2-2105225](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_114-e/Docs/R2-2105225.zip) | Further analysis on paging carrier selection options | Nokia, Nokia Shanghai Bells |

# 2 Discussion

10 papers have been submitted in this area. In order to have meaningful discussion and to get the most from the online session, it is suggested to list the comparisons on different aspects for the following two options:

* Option 1: UE selects a paging carrier based on a rule configured by the network
* Option 2: NW configures a specific paging carrier

## 2.1 General

[1], [2], [6] and [9] provide analysis on the division of carriers between legacy paging carriers and Rel-17 paging carriers, simple configuration of paging carriers which divides the set of carriers into two groups is proposed as basis for further discussion on paging carrier selection algorithm.

Proposal 1 For both options, RAN2 to discuss whether Rel-17 paging carriers and the legacy paging carriers should be exclusive.

[4] and [8] give analysis if there is any S1 interface impact. [4] mentions that there is S1 interface paging impact for option 2. However, [8] analyses that both options would not need changes in S1AP and the changes for paging carrier selection are pertaining to container definition.

Proposal 2 For both options, RAN 2 to discuss if S1AP update is needed.

For paging carrier selection based on coverage level, [3], [4], [6], [8] and [9] further provide analysis on either DRX based paging carrier selection, service based paging carrier selection, or power boosting impact to paging carrier selection.

Proposal 3 RAN 2 to discuss and decide whether and how to support:

* DRX based paging carrier selection
* service based paging carrier selection
* power boosting impact to paging carrier selection

## 2.2 How does NW configure/enable (dedicated, broadcast signalling?)

[1], [2], [3], [5] and [10] provide the view that NW configuration for Rel-17 paging carriers should be cell specific parameters, and better to be transmitted by broadcast signaling for both options.

Proposal 4 For both options, NW configuration for Rel-17 paging carriers is indicated in broadcast signalling.

For option 1, [1], [2], [3], [5], [9] and [10] provide the view on how NW and UE align on the selected Rmax/CE level, a list of sub-options could be further discussed.

[1] mentions that UE is allowed to select paging carrier group based on CEL. [2] gives the option that for option 1, UE reports the coverage status or paging carrier selection result to NW by dedicated signalling. While [3] provides that the evaluated CEL/Rmax would be assigned to a UE via dedicated signaling. In [9], UE signals to RAN that it prefers to use an *alternative paging carrier* during step 4, and in step 5, network confirms whether UE is permitted to use the *alternative paging carrier*. Further [5] listed all the above options.

Proposal 5 For option 1, RAN 2 to select between the following sub-options:

* Option 1a: No dedicated signalling, UE selects a carrier based on broadcast criteria only
* Option 1b: Network enables UE to select a Rel-17 paging carrier by enabling per UE in dedicated signalling.
* **Option 1c: Network enables UE to select a Rel-17 paging carrier by providing the coverage information (CEL/Rmax) for the carrier selection to the UE in dedicated signalling**
* **Option 1d: Network explicitly confirms a suggested paging carrier based on a UE report.**

For option 2, [1], [2], [3], [5], [8], [9] and [10] provide the view on how NW assigns a certain paging carrier to UE, a list of sub-options could be further discussed.

[1], [2], [3] and [8] provides the view that eNB assigns a paging carrier to a UE by dedicated signaling. While in [10], it gives another alternative to assign the paging carrier based on UE report. Further in [9], eNB indicates to the UE the criteria for selection paging carriers based on one or more factors, including Paging carrier specific Rmax, Paging carrier specific coverage level, Paging carrier specific DRX and Paging carrier ID.

Proposal 6 For option 2, RAN 2 to select between the following sub-options:

* Option 2a: NW provides the carrier explicitly via dedicated signalling based on information determined within the NW.
* Option 2b: NW provides the carrier explicitly via dedicated signalling based on additional UE metric report.
* Option 2c: NW provides the criteria for carrier selection via dedicated signalling based on one or more factors, including Paging carrier specific Rmax, Paging carrier specific coverage level, Paging carrier specific DRX and Paging carrier ID.

## 2.3 How does UE select carrier, based on what criteria and metrics?

Further, [2], [3], [4], [5], [8], [9] and [10] discuss the metric for UE to determine carrier suitability and to select paging carrier, a list of alternatives has been provided.

Proposal 7 For both options, UE metric for determining carrier suitability and selection is based on one of the alternatives:

* Alt 1: measured NRSRP.
* Alt 2: estimated Rmax.
* Alt 3: long-term evaluation of radio condition over multiple paging occasions.

## 2.4 What happens upon cell change?

Upon cell change, [2], [3], [4], [5], [6], [9] and [10] provide the view for option 1. Two alternatives are provided.

Proposal 8 For option 1, upon cell change:

* Alt 1: based on previously determined CEL and broadcasted paging carrier configuration in the new cell.
* Alt 2: UE needs to perform fallback mechanism.

Upon cell change, [2], [3], [4], [5], [6], [8], [9] and [10] provide the view that for option 2, UE needs to perform fallback mechanism.

Proposal 9 For option 2, upon cell change, UE needs to perform fallback mechanism.

## 2.5 What happens upon coverage change?

[2], [3], [4], [5], [6], [8], [9] and [10] provide the view that when radio condition remains or gets better, UE should remain on the current paging carrier; when radio condition gets worse, UE should adopt the fallback scheme.

Proposal 10 For both options, upon coverage change within the cell:

* When radio condition remains or gets better, UE should remain on the current paging carrier.
* When radio condition deteriorates, UE should adopt to fallback mechanism.

## 2.6 Details of the fallback carrier

[2], [3], [4], [5], [6], [8], [9] and [10] provide the view on which carrier should be configured as fallback carrier. Two alternatives are provided.

Proposal 11 For both options, fall back carrier should be configured as:

* Alt 1: legacy paging carrier based on UE\_ID
* Alt 2: network configured specific carrier other than the dedicated paging carrier

# Conclusion

Based on the discussion in the previous sections we propose the following:

Proposal 1 For both options, RAN2 to discuss whether Rel-17 paging carriers and the legacy paging carriers should be exclusive.

Proposal 2 For both options, RAN 2 to discuss if S1AP update is needed.

Proposal 3 RAN 2 to discuss and decide whether and how to support:

* DRX based paging carrier selection
* service based paging carrier selection
* power boosting impact to paging carrier selection

Proposal 4 For both options, NW configuration for Rel-17 paging carriers is indicated in broadcast signalling.

Proposal 5 For option 1, RAN 2 to select between the following sub-options:

* Option 1a: No dedicated signalling, UE selects a carrier based on broadcast criteria only
* Option 1b: Network enables UE to select a R17 paging carrier by enabling per UE in dedicated signalling.
* **Option 1c: Network enables UE to select a R17 paging carrier by providing the coverage information (CEL/Rmax) for the carrier selection to the UE in dedicated signalling**
* **Option 1d: Network explicitly confirms a suggested paging carrier based on a UE report.**

Proposal 6 For option 2, RAN 2 to select between the following sub-options:

* Option 2a: NW provides the carrier explicitly via dedicated signalling based on information determined within the NW.
* Option 2b: NW provides the carrier explicitly via dedicated signalling based on additional UE metric report.
* Option 2c: NW provides the criteria for carrier selection via dedicated signalling based on one or more factors, including Paging carrier specific Rmax, Paging carrier specific coverage level, Paging carrier specific DRX and Paging carrier ID.

Proposal 7 For both options, UE metric for determining carrier suitability and selection is based on one of the alternatives:

* Alt 1: measured NRSRP.
* Alt 2: estimated Rmax.
* Alt 3: long-term evaluation of radio condition over multiple paging occasions.

Proposal 8 For option 1, upon cell change:

* Alt 1: based on previously determined CEL and broadcasted paging carrier configuration in the new cell.
* Alt 2: UE needs to perform fallback mechanism.

Proposal 9 For option 2, upon cell change, UE needs to perform fallback mechanism.

Proposal 10 For both options, upon coverage change within the cell:

* When radio condition remains or gets better, UE should keep on the current paging carrier.
* When radio condition deteriorates, UE should adopt to fallback mechanism.

Proposal 11 For both options, fall back carrier should be configured as:

* Alt 1: legacy paging carrier based on UE\_ID
* Alt 2: network configured specific carrier other than the dedicated paging carrier