**3GPP TSG-RAN WG2 Meeting #116bis electronic  *R2-210xxxx***

**Online, Jan 17th – 25th 2022**

**Agenda item: 9.1.3**

**Source: ZTE (email discussion rapporteur)**

**Title: Report of [AT116bis-e][301][NBIOT/eMTC R17] Carrier selection (ZTE)**

**Document for: Discussion and Decision**

# Introduction

This document is the report of the offline email discussion “*[AT116bis-e][301][NBIOT/eMTC R17] Carrier Selection*”, as indicated below:

* *[AT116bis-e][301][NBIOT/eMTC R17] Carrier Selection (ZTE)*

***Status****: Started*

***Scope:*** *Progress the outcome of email discussion [Post116-e][311] to have a set of agreeable proposals and a set of open issues/FFS.*

***Intended outcome:*** *Report in R2-2201786 to treat in wk2 online session (and “easy” agreements by email before the online session, if possible)*

***Deadline:*** *Friday 21 January 1200 UTC.*

# Contact information

Please provide your contact information when feedback:

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# Discussion

In the email discussion “*[Post116-e][311][NBIOT/eMTC R17] NB-IoT carrier selection*”, many aspects have been discussed for the Option 1c and several proposals have been given.

In this email discussion, we firstly have a idscussion on the “easy” proposals from “*[Post116-e][311]“* to see whether all or part of them can be quickly agreed. Then we can discuss those “for discussion” proposals. The new contributions to this meeting would be also taken into account.

## Proposals for “easy agreements”

The following proposals for "easy agreements" have been given in [R2-2200030]. Companies are invited to indicate which one(s) cannot be agreed? Companies can further indicate technical reasons or give wording suggestion in order to make it agreeable.

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| **Proposals for "easy agreements":****Proposal 2: UE can be enabled/disabled** **coverage-based paging carrier selection via dedicated signalling. Presence or absence of the coverage information can be implicit enable/disable indication.****Proposal 3: In SIB, one or more R17 paging carriers can be configured with a same Rmax (npdcch-NumRepetitionPaging) parameter, which means these paging carriers are corresponding to a same coverage level.****Proposal 4: In SIB, at most 2 coverage levels can be configured in R17 paging carrier list.****Proposal 5: In SIB, the value range for Ramx (npdcch-NumRepetitionPaging) in R17 paging carrier (list) configuration can be ENUMERATED {r1, r2, r4, r8, r16, r32, r64, r128}.****Proposal 6: In SIB, coverage specific nB is supported, e.g., a common nB value is configured for the R17 paging carrier(s) with same Rmax (npdcch-NumRepetitionPaging).****Proposal 8: In SIB, coverage specific ue-SpecificDRX-CycleMin is supported, e.g., a common ue-SpecificDRX-CycleMin value is configured for the R17 paging carrier(s) with same Rmax (npdcch-NumRepetitionPaging).****Proposal 9: Paging weight can still be used in coverage-based paging carrier selection.****Proposal 10: In SIB, both non-mixed operation mode and mixed operation mode can be supported in R17 paging carrier list configuration. They can be configured separately (as legacy).****Proposal 11: The extension in SIB22-NB can be used for providing R17 paging carrier list configuration.****Proposal 13: In SIB, coverage specific NRSRP threshold is supported, e.g., a common NRSRP threshold value is configured for the R17 paging carrier(s) with same Rmax (npdcch-NumRepetitionPaging).****Proposal 15: No “offset” (headroom) would be introduced for the configured NRSRP threshold.** |

**Q1: Companies are invited to give comments on whether or not the above proposals for "easy agreements" can be agreed. For the one that cannot be agreed, please indicate the reason or provide wording suggestions:**

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| **Company** | **Which proposal cannot be agreed** | **Additional comments or suggestions** |
| ZTE | None |  |
| Huawei, HiSilicon | P13 | Altough we agree with the intention of signaling the NRSRP threshold in SIB, we cannot agree with the wording as it implies that the UE is configured with a Rmax via dedicated signaling and which is not our preference. On our view, a ‘coverage level’ is defined by two NRSRP thresholds, one of them being possibly default/infinity. We propose the following**P13: In SIB, NRSRP thresholds are signaled for the selection criterion of a R17 paging carrier. R17 paging carriers with the same Rmax (npdcch-NumRepetitionPaging) are associated to the same NRSRP thresholds.** |
| Qualcomm | None |  |
| Nokia | P13 | Agree with Huawei modification. |

**Conclusion:**

## Proposals for further discussion

### Issue#1: Information in dedicated signalling

In the email discussion “*[Post116-e][311]*”, 5 companies are fine to provide a Rmax information, e.g., npdcch-*NumRepetitionPaging* to the UE in dedicated signaling (when UE is released to idle). 3 companies are fine with another option, e.g., to provide NRSRP threshold in dedicated signaling. Therefore, the **Proposal 1** in [R2-2200030] still needs to be discussed. In [[R2-2200682](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200682.zip)], companies give more comparison between Rmax and other option.

**Q2: Do companies agree Rmax information, e.g., *npdcch-NumRepetitionPaging* is provided to the UE in dedicated signaling (when UE is released to idle)?**

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| **Company** | **Yes/No** | **Additional comments** |
| ZTE | Yes | 1. If a NRSRP threshold is provided to UE in dedicated signaling, it may be possible that several CELs are determined to the UE and the suitability check for several Rmax(s) are fulfilled. This will cause ambiguity when determining the candidate R17 paging list for the UE and furthermore cause potential inconsistence between UE and network.

For example, we may provide the following configuration in SIB:

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| Rmax | The corresponding carrier list | The NRSRP threshold for suitability checking for this Rmax |
| 4 | f1, f2 | -110dB (can approximately correspond to CEL0) |
| 32 | f3, f4 | -120dB (can approximately correspond to CEL1) |

If Rmax = 32 is assigned to the UE in dedicated signaling, via mapping its assigned UE-specific Rmax with the Rmax in SIB, the UE firstly can know that the R17 carrier list (f3, f4) would be the candidate R17 paging carrier list. The UE would further check whether its current serving cell NRSRP (for example, -100dB) is higher (better) than the NRSRP threshold (-120dB) for Rmax = 32, if Yes, that means the suitability checking is fulfilled, UE can use the R17 carrier list (f3, f4) in the following paging carrier selection scheme. Otherwise, e.g, UE’s current serving cell NRSRP is less than the NRSRP threshold (-120dB), that means the suitability checking isn’t fulfilled, the UE would fall back to legacy paging carrier selection. However, if a NRSRP threshold, e.g., -120dB, is provided to UE in dedicated signaling, the case may be a bit complicated. As it’s a threshold for determining the coverage, if UE’s current serving cell NRSRP (for example, -100dB) is equal to or higher (better) than -120dB, it may be not easy to just say that UE is in CEL1 and the Rmax = 32 would be used. As the UE’s current serving cell NRSRP is also higher (better) than -110dB (the suitability check criteria for Rmax = 4), it may be also correct to say that UE is in CEL0 and the suitability check for Rmax = 4 is fulfilled. This may further cause inconsistence between UE and network. We think this might be avoided with additionally restriction in the field description of the NRSRP threshold in dedicated signaling, but that would introduce more unnecessary complexity.1. If a NRSRP threshold is provided to UE in dedicated signaling, it may cause more confusion and more specification impacts in RAN3, e.g., new additional IE (which is aligned with the possible NRSRP threshold IE in RRC release message) needs to be introduced into S1/NG signaling that would cause more complicated RAN3 impacts.
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| Huawei, HiSilicon | No | We think that UE should be configured with a coverage level/ paging group index, same principle as NPRACH resources selection.Taking ZTE example above, Rmax = 4 would corresponds to index 0 and Rmax = 32 to index 1.UE checks its measured NRSRP compared to the thresholds. If the measured level is the same as the assigned level, then the UE can select a carrier in the corresponding coverage level.  |
| Qualcomm | No | Given there can be at most 2 lists of coverage based paging carriers hence at most 2 Rmax and NRSRP values can be configured in the SIB. Both UE and network should select one of the two coverage-based paging carrier lists based on the reported measurement.Therefore, we do not see network needs to provide Rmax or NRSRP but we do think network should have control whether UE is allowed to use coverage-based paging carriers via dedicated signalling. For this reason, we think it is sufficient for the network to provide index to one of the two lists (effectively a 1-bit value) then both the UE and network knows what Rmax and NRSRP to use from the broadcast signalling.If the network does not indicate which one of the two lists of coverage-based paging carriers lists UE is to select a coverage-based paging carrier then UE and network only select paging carrier from legacy list as per legacy rules. |
| Nokia | No | We propose to configure upto two coverage based paging group configurations consists of threshold,NB and other common parameters. Rel-17 carrier should have index pointing to one of these group. Based on given threshold UE select the carriers having the corresponding paging group index. In dedicated signalling also NW can provide pointer to these groups instead of NRSRP threshold value. But we are OK to allow configuring threshold in dedicated signalling to allow NW to do this independently. |

### Issue#2: Coverage specific DRX cycle

In the email discussion “*[Post116-e][311]*”, 4 companies are fine to introduce coverage specific DRX cycle while 3 companies think no need to specify coverage specific DRX cycle and it’s enough to apply cell specific default DRX cycle. Therefore, the **Proposal 7** in [R2-2200030] still needs to be discussed.

**Q3: Do companies agree to support coverage specific DRX cycle?**

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| **Company** | **Yes/No** | **Additional comments** |
| ZTE | No strong view | Slightly prefer to introduce coverage specific DRX cycle. But also fine without it.  |
| Huawei, HiSilicon | No | We do not see the benefit (the CN only knows the cell default DRX and the UE specific DRX, so will page accordingly) and we see the drawback that the UE with no latency requirement (i.e. no UE specific DRX) will have to measure more often than in legacy.  |
| Qualcomm | Yes | We consider it is useful to support coverage-specific UE-specific DRX. Coverage-specific DRX would not be used for coverage-based paging carrier selection, but it can be useful for a UE that can benefit from shorter DRX cycle. A UE that has not requested UE specific DRX would use the default DRX. From specification point of view, it is relatively easy to support. |
| Nokia | Yes | Agree with QC. This is one of the main benefit for UE in normal coverage for having coverage based paging group (carrier group) |

### Issue#3: Procedure for suitability checking of assigned info and carrier selection

In the email discussion “*[Post116-e][311]*”, the proposal 12 give a general procedure for suitability checking of the assigned coverage information and R17 paging carrier selection. As some modifications have been introduced in TS 36.331 running CR and TS 36.304 running CR, rapporteur suggest not to pursue **Proposal 12** in [R2-2200030].

### Issue#4: Time offset for suitability checking of assigned info

In the email discussion “*[Post116-e][311]*”, 4 companies seems fine with that a fixed (e.g., one eDRX cycle) or configurable timer period can be applied when UE compares its serving cell NRSRP with the NRSRP threshold. The other companies think this can be left to UE implementation which can avoid RAN4 impacts. Therefore, the **Proposal 14** in [R2-2200030] still needs to be discussed.

Q4: Do companies agree that a configurable timer period can be applied when UE compares its serving cell NRSRP with the NRSRP threshold**?**

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| **Company** | **Yes/No** | **Additional comments** |
| ZTE | Yes | We agree it’s beneficial to let the suitability checking based on NRSRP continue for a time period to ensure a stable evaluation result. |
| Huawei, HiSilicon | Yes | We think it is beneficial not to use instantaneous values as this is likely to cause ping pong. We think that RAN4 filtering requirement (at least two measurements spaced by DRX/2 may not be enough). we think that having the criteria check again a configurable duration (same as for cell reselection) is a good approach |
| Qualcomm | Yes | The time period should be configurable to allow for cell optimisation. |
| Nokia | Yes |  |

### Issue#5: “restriction” for that the UE does not switch paging carrier

In the email discussion “*[Post116-e][311]*”, 4 companies agree to introduce a “restriction” that the UE does not switch paging carrier if it has stayed less than [xx] seconds on the carrier or within a PTW. The other 3 companies disagree or think this can be left to UE implementation. Therefore, the **Proposal 16** in [R2-2200030] still needs to be discussed. In [[R2-2201021](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201021.zip)], companies further suggest to introduce hysteresis criteria for switching between legacy paging carrier and coverage based paging carrier. But the details need to be clarified.

Q5: Do companies agree to specify that UE does not switch paging carrier if it has stayed less than [xx] seconds on the carrier or within a PTW. The xx seconds can be decided in stage-3. Other suggestion can be indicated in the comments column.

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| **Company** | **Yes/No** | **Additional comments** |
| ZTE | Yes | We are fine with that UE should use the same paging carrier during the PTW. |
| Huawei, HiSilicon | Yes | We also wonder on the measurement impacts of switching carrier at each paging occasion.  |
| Qualcomm | Yes |  |
| Nokia | Yes | Selected paging carrier should be same for all PO of PTW. |

### Issue#6: UE report

In the email discussion “*[Post116-e][311]*”, 5 companies indicates some UE report would be helpful to NW, e.g., help NW to provide suitable Rmax value or configure suitable paging carrier selection parameters. 1 company think existing report is not suitable for eNB to decide suitable Rmax. 2 companies oppose that UE indicates a preferred carrier to NW. Therefore, the **Proposal 17** in [R2-2200030] still needs to be discussed. In [[R2-2201021](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201021.zip)], companies further suggest that UE indicates to network that the reported measurement has meet the hysteresis criteria. Only if the UE has sent such indication UE can use coverage-based paging carrier in RRC\_IDLE. Per rapporteur’s understanding, this indication similar as the option2 in Q6.

**Q6:For assisting eNB to assigned suitable Rmax information in dedicated signaling, companies are invited to indicate which information below can be reported by the UE to network and how?**

* **Option1: UE measured NRSRP (to make legacy Msg5 report mandatory or via other way?)**
* **Option2: An indication on whether the existing CQI report is suitable for coverage-based paging carrier selection.**

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| **Company** | **Preferred option** | **Additional comments** |
| ZTE | Option 1 | We are fine to make the legacy Msg5 report mandatory. But just note this is no use in EDT and PUR procedure (we assume Msg4 in EDT or PUR procedure can also be used to assign Rmax information to UE).For option 2, we are not clear the timing for the UE to send such indication. |
| Huawei, HiSilicon | Option 1 | eNB can cross check the reported measurement, vs the used NPRACH resources, vs the needed number of repetitions used in DL. So it can get a good idea of the reliability of the reported value. |
| Qualcomm | Option 2 | We consider the legacy measurement report is inadequate for coverage-based paging carrier selection, it is a very short-term measurement and can lead to selection of wrong coverage-based paging carrier. For more information see [R2-2201021](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201021.zip%22%20%5Co%20%22https%3A//www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201021.zip). |
| Nokia | Option 1 |  |

## Other issues

### Issue#7: Signalling for CEL-based paging carrier configuration

In [R2-2201022], Signalling approach 1 and Signalling approach 2 are further compared.

Q7: Companies are invited to indicate which signalling approach is preferred?

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| **Company** | **Preferred****Signalling** | **Additional comments** |
| ZTE | Signalling approach 1 | In Signalling approach 2, a new carrier list *DL-ConfigCommonList* is introduced. But the carriers in this new list cannot be used for DL carrier for RAR. We think this is unnecessary restriction.During email discussion “*[Post116-e][311]*”, we have given a variant of Signalling approach 1, we suggest to further consider this. For simplicity, here *maxRmaxNumber-NB-r17* can be set to 2 to aligned with **Proposal 4** in [R2-2200030]:SystemInformationBlockType22-NB-r14 ::= SEQUENCE { // omit the unchanged part// ul-ConfigList-r15 UL-ConfigCommonListTDD-NB-r15 OPTIONAL -- Cond TDD ]], [[ PCCH-ConfigList-NB-r17 ::= SEQUENCE (SIZE(1..maxRmaxNumber-NB-r17)) OF PCCH-Config-NB-r17 OPTIONAL, -- Need OR ]]}// omit the unchanged part//DL-ConfigCommon-NB-r14 ::= SEQUENCE {// omit the unchanged part// [[ gwus-Config-r16 WUS-ConfigPerCarrier-NB-r15 OPTIONAL -- Cond GWUS ]], [[ PCCH-ConfigIndex-r17 INTEGER(1..maxRmaxNumber-NB-r17) OPTIONAL – Cond PCCH-Config-r14 ]]}PCCH-Config-NB-r14 ::= SEQUENCE {// omit the unchanged part//}PCCH-Config-NB-r17 ::= SEQUENCE { npdcch-NumRepetitionPaging-r17 ENUMERATED { r1, r2, r4, r8, r16, r32, r64, r128, r256, r512, r1024, r2048, spare4, spare3, spare2, spare1} OPTIONAL, -- Need OP pagingWeight-r17 PagingWeight-NB-r14 DEFAULT w1, defaultPagingCycle-r17 ENUMERATED {rf32, rf64, rf128, rf256, rf512, rf1024} OPTIONAL, -- Need OR ue-SpecificDRX-CycleMin-r17 ENUMERATED {rf32, rf64, rf128, rf256, rf512, rf1024} OPTIONAL, -- Need OR nB-r17 ENUMERATED { fourT, twoT, oneT, halfT, quarterT, one8thT, one16thT, one32ndT, one64thT, one128thT, one256thT, one512thT, one1024thT, spare3, spare2, spare1} OPTIONAL, -- Need OR rsrpThreshold-r17 RSRP-Range, …}// omit the unchanged part// |
| O | signalling approach1 | signaling approach 2 (new list) does not allow to use the R17 paging carriers as DL carrier for NPRACH which we see as a limitation.However we do not agree with the example above , we rather have something similar to below:SystemInformationBlockType22-NB-r14 ::= SEQUENCE {...[[ PCCH-ConfigList-NB-r17 ::= SEQUENCE (SIZE(1..maxPagingGroups-NB-r17)) OF PCCH-Config-NB-r17 OPTIONAL, -- Need OR ]]}PCCH-Config-NB-r14 ::= SEQUENCE {// omit the unchanged part//}PCCH-Config-NB-r17 ::= SEQUENCE { ue-SpecificDRX-CycleMin-r17 ENUMERATED {rf32, rf64, rf128, rf256, rf512, rf1024} OPTIONAL, -- Need OR nB-r17 ENUMERATED { fourT, twoT, oneT, halfT, quarterT, one8thT, one16thT, one32ndT, one64thT, one128thT, one256thT, one512thT, one1024thT, spare3, spare2, spare1}, dl-ConfigList-r17 SEQUENCE (SIZE (1.. maxNonAnchorCarriers-NB-r14)) OF DL-CarrierIndex-NB-r17, dl-ConfigListMixed-r17 SEQUENCE (SIZE (1.. maxNonAnchorCarriers-NB-r14) OF DL-CarrierIndex-NB-r17 OPTIONAL, -- Cond MixedMode ...}DL-CarrierIndex-NB-r17 ::= INTEGER (1.. maxNonAnchorCarriers-NB-r14)RSRP-ThresholdsPagingGroupList-NB-r13 ::= SEQUENCE (SIZE(1.. maxPagingGroups-NB-r17)) OF RSRP-Range// omit the unchanged part// |
| Qualcomm | Signalling approach 2 | Coverage-based paging carrier list is an alternative list and not an extension/enhancement of legacy list. Therefore, conceptually it is much easier to understand with signalling approach 2. |
| Nokia  | Approach 2 with changes |  We have proposed to define group configuration and refer this index in Rel-17 paging carrier list. This is optimised signalling in SIB. |

### Issue#8: Enable CEL-based paging carrier selection

In [[R2-2201076](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201076.zip)], company suggest that the paging carrier selection feature can be considered enabled once the network provides the relevant parameters when releasing the UE to idle.

Q8: Do companies agree that coverage based paging carrier selection is enabled implicitly, i.e., when relevant parameters are provided to the UE during release?

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| **Company** | **Yes/No** | **Additional comments** |
| ZTE | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Qualcomm | Yes | Also see our response to Q2. |
| Nokia | Yes | Seems like question is repeated. |

### Issue#9: Rel-17 coverage based paging carrier is used as DL carrier for RAR

In [[R2-2200922](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200922.zip)], company think there is no reason why the Rel-17 paging carrier should not be used as the DL carrier for random access.

Q9: Do companies agree that the Rel-17 paging carrier can also be used as the DL carrier for random access?

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| **Company** | **Yes/No** | **Additional comments** |
| ZTE | Yes |  |
| Huawei, HiSilicon | Yes | This means that the legacy lists are used to provide the DL carrier configuration |
| Qualcomm | Yes | We actually don’t see what impact this would have on the specification as any carrier in *DL-ConfigCommonList-NB-r14* can be used for NPDCCH for random access (see *npdcch-CarrierIndex-r14*). In release 17 the only restriction is that a downlink non-anchor carrier used for coverage-based paging carrier shall not be used in legacy non-anchor paging carrier list. |
| Nokia | Yes | We don’t see reason to restrict this option. |

### Issue#10: Subgroup of paging carriers for the more easily changed CE level

In [[R2-2200633](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200633.zip)], company suggest that one subgroup of paging carriers should be allocated for the more easily changed CE level. And if the measured RSRP variation range exceeds the configured threshold over a period of time, the UE can be considered to have the more easily changed CE level.

Q10: Do companies agree that one subgroup of paging carriers should be allocated for the more easily changed CE level?

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| **Company** | **Yes/No** | **Additional comments** |
| ZTE | No | It’s not clear how the eNB to decide the paging carrier for such UE (how to guarantee the consistence between UE and gNB?). |
| Huawei, HiSilicon | No |  |
| Qualcomm | No | This seems to be adding a third group of coverage-based paging carrier list. It is not clear what ‘more easily changed CE level’ means. |
| Nokia | No |  |

# Conclusion

**TBD**

# References

[1] R2-2200030 Report of [Post116-e][311] NB-IoT carrier selection, ZTE Corporation, Sanechips, RAN2#116bise

[2] [R2-2200633](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200633.zip) The remaining issues on enhanced paging carrier selection, Spreadtrum Communications, RAN2#116bise

[3] [R2-2200676](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200676.zip) Further details on coverage level based paging carrier selection, Nokia, Nokia Shanghai Bells, RAN2#116bise

[4] [R2-2200682](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200682.zip) Remaining FFSs on CEL-based paging carrier selection, ZTE Corporation, Sanechips, RAN2#116bise

[5] [R2-2200922](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200922.zip) Discussion on details of paging carrier selection, MediaTek Inc. , RAN2#116bise

[6] [R2-2201021](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201021.zip) Paging carrier selection with hysteresis Qualcomm Incorporated, RAN2#116bise

[7] [R2-2201022](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201022.zip) Signalling for coverage-based paging carrier selection, Qualcomm Incorporated, RAN2#116bise

[8] [R2-2201076](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201076.zip) Remaining issues of carrier selection, Ericsson, RAN2#116bise