**3GPP TSG-RAN WG4 Meeting # 98-e** **R4-2103309**

Electronic Meeting, Jan. 25-Feb. 5, 2021

**Agenda item:** 9.22

**Source:** Moderator (Huawei)

**Title:** Email discussion summary for [98e][121] NR\_FR1\_35MHz\_45MHz\_BW

**Document for:** Information

# Introduction

The scope of this email discussion is to discuss the contributions submitted at agenda 9.22 on introduction of channel bandwidths 35MHz and 45MHz for NR. The following topics are discussed in the email discussion.

* Topic#1: General part
	+ Sub-topic 1-1: Work plan
* Topic#2: Spectrum utilization
	+ Sub-topic 2-1: Channel raster and PRB grid alignment
	+ Issue 2-2: Spectrum utilization
* Topic#3: UE RF requirements
	+ Sub-topic 3-1: n1 45MHz REFSENS
	+ Sub-topic 3-2: n3 35MHz and 45 MHz REFSENS
	+ Sub-topic 3-3: n8 and n71 REFSENS
	+ Sub-topic 3-4: n25 35MHz and 45MHz REFSENS
	+ Sub-topic 3-5: n2 and n25 A-MPR
	+ Sub-topic 3-6: n1 A-MPR
* Topic #4: UE CRs
* Topic#5: BS CRs

# Topic #1: General part

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2101501 | Huawei, HiSilicon | Proposal 1: it is proposed to provide formal Rel-17 CRs at RAN4#98-e as long as the requirements are finalized at least for one band. If RAN accepts the WI will be extended for the remaining work for other bands if any. |
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## Open issues summary

### Sub-topic 1-1

**Issue 1-1:** **Work plan**

* Proposals
	+ Option 1: technical endorse the CR for the band(s) which the requirements are finalized and extend the WI
	+ Option 2: approve the CR for some band finalized in this meeting and the CRs for remaining band(s) will come in future meeting.
* Recommended WF
	+ It is proposed to agree one of the options above at 1st round discussion

## Companies views’ collection for 1st round

### Open issues

**Comments on work plan**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| China Telecom | We have slightly preference to agree the CR’s for some completed bands in this meeting in order to make progress according to the WI timeline, and then continue discuss the remaining bands in next meeting. |
| Ericsson | Open for option 1. We would like to see an equal completion level for both UE and BS CR’s before agreeing them to be implemented into specifications. I.e. preferably not agree BS CR’s and continue with UE CR’s in coming meeting (if WI is extended). BS CR’s seems more complete at this stage. |
| AT&T | Option 1. Based on RAN #90-e decision to extend the Rel-17 timeline, we should consider a similar extension to this WI and to give time to complete the new CBW requests approved by RAN as part of the WI.  |
| ZTE | Slight prefer to Option 2. But we have a question for clarification, without extend the WID, how to treat the bands whose RF requirements are not completed? In basket WID way? |
| Huawei | We are open for both options. We need a decision at 1st round and then work on the CR or draft CR for 2nd round.To ZTE: our preference is to extend the WI for the band is already in the WID. |
| Apple | Option 1 is preferred. |
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## 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: Work plan | Based on 1st round comments, 2 companies support option 1 and 2 companies show slightly preference on option 1. Moderator think a decision at 1st round is important for the progress. Considering that if no agreement is reached, we will follow normal procedure which is option 1.Moderator suggestion: Option 1 and no further discussion for 2nd round  |
|  |  |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| N/A |  |  |

### 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**  |
|  |  |

## Discussion on 2nd round (if applicable)

None

## 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*

# Topic #2: Spectrum utilization

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2102192 | ZTE Corporation | Remove [] for the SU values for 35MHz and 45MHz in the table.

|  |  |  |
| --- | --- | --- |
| SCS (kHz) | 35MHz | 45MHz |
| NRB | NRB |
| 15 | 188 | 243 |
| 30 | 92 | 119 |
| 60 | 44 | 58 |

 |
| R4-2100753 | Nokia, Nokia Shanghai Bell | *Observation 1: The PRB grid alignment between new and legacy channel bandwidths is important.**Observation 2: The PRB grid alignment can be maintained by reducing the number of PRBs in either the legacy or the new channel bandwidth.**Observation 3: Applying a 5 kHz channel raster for the legacy UEs' channel bandwidth (similar to a bandwidth part) can also solve the PRB grid alignment.**Proposal 1: The UE support of all NR-ARFCN with 5 kHz granularity for FR1 bands with 100 kHz channel raster shall be assumed for a smaller UE channel bandwidth operating inside a wider channel bandwidth, and this understanding shall be clarified in TS 38.101-1, e.g. in the subclauses 5.3.1 and 5.4.2.3.* |

## Open issues summary

### Sub-topic 2-1

**Issue 2-1: Channel raster and PRB grid alignment**

* Proposals

To maintain the channel raster and PRB grid alignment between the new and legacy channel bandwidths,

* + Option 1: adjust the number of PRBs for 45 MHz， e.g. NRB=242.
	+ Option 2: configure NRB=215 for 40 MHz CBW for the legacy UE
	+ Option 3: Apply a 5 kHz channel raster for FR1 bands with 100 KHz channel raster
* Recommended WF
	+ TBD

### Sub-topic 2-2

**Issue 2-2: Spectrum utilization**

* Proposals
	+ Remove [] for the SU values for 35MHz and 45MHz
* Recommended WF
	+ Approve the proposal to remove [].

## Companies views’ collection for 1st round

### Open issues

**Comments on Issue 2-1: Channel raster and PRB grid alignment**

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| --- | --- |
| **Company** | **Comments** |
| Ericsson | **Issue 2-1:** We are supportive of option 1. We are checking further regarding option 2 & 3. |
| Qualcomm | Prefer option 1. |
| ZTE | **Issue 2-1: Channel raster and PRB grid alignment**For option 1, we think it will impact the ongoing MPR/A-MPR evaluation work.Option 2 can work. The cell specific DL channel bandwidth configured for all UEs could be configured by servingCellConfigCommon signalling.For option 3, for band above 3GHz, 15kHz is the granularity, 5kHz granularity is only applicable for the band blow 3GHz, if it is applied to all FR1 band, then it seems it will impact on the existing design.. Also we have a question for clarification: Is the PRB grid issue only for new added 45MHz CBW, or also for the other CBWs since there are lots of cases that even/odd PRB configurations? Also, due to 45MHz are only defined for some bands, if there are no legacy UE for some certain band to access to 45MHz network, then no need to consider the grid alignment issue. **Issue 2-2: Spectrum utilization**Agree to remove [] for the SU values for 35MHz and 45MHz. |
| Huawei | We prefer option 1. Option 2 might work but we have to check with all UE vendors if this is common understanding to avoid NBC issue. |
| MediaTek | We prefer option 1. |
| Nokia | For ZTE:• We think MPR/A-MPR can be reused for a lower SU, but we cannot exclude that then the allowed power reduction is slightly higher than needed because the guard band increases.• Option 3 does not propose to apply 5 kHz to all FR1 bands, but only to the FR1 bands with 100 kHz channel raster, all of which are below 3 GHz. Hence there is no change in NR-ARFCN granularity and hence, to our understanding, no design change.• Concerning the question for clarification: If, at 15 kHz SCS, the network's transmission BW is centred according to the 100 kHz channel raster and has an even (odd) number of PRBs and the UE can only be configured a lower transmission BW than the network, the corresponding UE channel bandwidth can only be also centred according to the 100 kHz channel raster if the UE's transmission BW has also an even (odd) number of PRBs. The difference between even and odd causes an offset of the PRB edges of 6 subcarriers according to k in TS 38.104 table 5.4.2.2-1, i.e. 90 kHz at 15 kHz SCS. By shifting the offset by multiples of a PRB size, i.e. 180 kHz, also the shifted offset (90 kHz, 270 kHz, 450 kHz, …) can never be a multiple of 100 kHz. After double-checking the general case, we think that the problem is limited to the SCS of 15 kHz. Hence the transmission BW at 30 kHz need not be lowered to allow for placing both the BS channel BW of 45 MHz and the UE channel BW of 40 MHz onto the 100 kHz channel raster.If there are no legacy UEs and all new UEs support the network's transmission BW, there is no problem either, of course.Nokia's preference is, if legacy UEs tolerate it, option 3 because removing an unnecessary restriction simplifies the choice of the UE's transmission BW size and position considerably. If option 3 was not possible, we would prefer reducing the transmission BW configuration at 15 kHz SCS from 243 to 242 PRBs (option 1). |
| Apple | For Option 1, we can consider two sub-options. Either we just reduce the number of RBs for the 45MHz channel or we keep it as it is, but the network will lose on RB if it decides to schedule legacy and new UEs in the same TTI. If only new UEs are scheduled, then all RBs should be available.For Option 3, it would be nice if Nokia explains which changes they want to have before we can agree to it.RB alignment is of course beneficial for flexible scheduling of legacy and new devices, but it is not absolutely needed because the network can control in which TTI new or legacy UEs will be scheduled. In fact, both new and legacy UEs can be scheduled in the same TTI at the expense of losing one RB. So, Option 1 can be viewed as two possible sub-options: a) either we reduce number of available RBs for the 45MHz channel as a constant value, or b) the effective number of schedulable RBs will reduce by one if the network decides to allocate resources for legacy and new UEs in the same TTI. Option 3 needs further clarification. According to TS 38.101-1, “For NR operating bands with 100 kHz channel raster, ΔFRaster = 20 × ΔFGlobal. In this case every 20th NR-ARFCN within the operating band are applicable for the channel raster within the operating band and the step size for the channel raster in Table 5.4.2.3‑1 is given as <20>”, so it is not entirely clear which specification impact we will have in this case. |

**Comments on Issue 2-2: Spectrum utilization**

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| --- | --- |
| **Company** | **Comments** |
| Ericsson | **Issue 2-2:**We are fine with removing [] for 35MHz but since there is still open issues in Issue 2-1 we like to wait on removing them for 45Hz |
| Huawei | Remove the [] when issue 2-1 is solved. |
| Nokia | Ok to remove once issue 2-1 is sorted out. |
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## 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 2-1: Channel raster and PRB grid alignment | Based on 1st round discussion, option 1 have more supporting companies. And companies are still checking whether there are NBC issues to legacy UE for option 2~4.Option 1: Ericsson, Qualcomm, Huawei, MediaTek, Option 2: ZTEOption 3: NokiaOption 4 (two sub-options): AppleRecommendation for 2nd round: further check whether option 1 is acceptable and capture the potential agreements in the WF1 |
| Issue 2-2: Spectrum utilization | Based on 1st round comments, all companies are ok to remove the [] when Issue 2-1 is solved.* Tentative agreements
	+ Remove [] for the SU values when Issue 2-1 is solved

Recommendation for 2nd round: Agree on the tentative agreements above and capture it in WF1 |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| WF1 | WF on spectrum utilization for 35MHz and 45MHz | Huawei |

## Discussion on 2nd round (if applicable)

R4-2103186 Way forward on spectrum utilization for 35MHz and 45MHz

Source: Huawei

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| --- | --- |
| **WF number** | **Comments collection** |
| Draft R4-2103186 | ZTE：For option 1, we have two questions:1: The PRB grid nesting issue only focus on 45MHz@15kHz SCS, i.e. 243PRB vs. 242 PRB. However when we comparing with 40MHz as follow:

|  |  |  |
| --- | --- | --- |
| SCS (kHz) | 40MHz | 45MHz |
| NRB | NRB |
| 15 | 216 | 243 |
| 30 | 106 | 119 |
| 60 | 51 | 58 |

It seems for 30kHz and 60kHz, the PRB grid nesting for odd RB and even RB cannot align comparing with 40MHz and 45MHz PRB, which means similar with 15kHz SCS case, the PRB for 45MHz @30kHz/60kHz might also have PRB grid nesting issue, does it needs to reduce 1RB for 30kHz and 60kHz for 45MHz if option 1 for 15kHz is adopted?2: Are the ongoing MPR/A-MPR, REFSENs requirements needed to be re-evaluated with the new NRB value for 45MHz@15kHz? If yes, can the re-evaluation work be completed in this meeting? |
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## Summary on 2nd round (if applicable)

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# Topic #3: UE RF requirements

## Companies’ contributions

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| --- | --- | --- |
| **T-doc number** | **Company** | **Title** |
| R4-2100516 | Apple Inc. | A-MPR Proposal for n1 and 45MHz CBW |
| R4-2100517 | Apple Inc. | A-MPR Proposal for n2 and 35MHz CBW |
| R4-2100518 | Apple Inc. | A-MPR Proposal for n25 and 45MHz CBW |
| R4-2100703 | Murata Manufacturing Co Ltd. | REFSENS of n8 and n71 for 35MHz channel bandwidth |
| R4-2100705 | Murata Manufacturing Co Ltd. | REFSENS of n25 for 45MHz channel bandwidth |
| R4-2101159 | Mediatek India Technology Pvt. | REFSENS evaluation of n8 and n71 for 35MHz channel bandwidth  |
| R4-2101177 | Qualcomm Incorporated | 35MHz 45MHz AMPR, MPR, REFSENS for n8, n71, and n25. |
| R4-2101502 | Huawei, HiSilicon | UE REFSENS for 35 MHz and 45 MHz |
| R4-2102592 | Apple Inc. | MSD considering asymmetric UL/DL for bands n8 and n71 |
| R4-2102927 | Skyworks Solutions Inc. | 35MHz 45MHz REFSENS |

Summary of REFSENS proposals from companies:

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| --- |
| REFSENS (15 KHz SCS) |
| Company | n1 | n2 | n3 | n8 | n25 | n71 |
| 45 | 35 | 35 | 45 | 35 | 35 | 45 | 35 |
| worst | Mid | Best | worst | Best | worst | Mid | Best |
| Murata |  |  | -86 | -84.2 | -64 |  | -85.2 | -85.4 | -77.4 |  | -69.1 |  | -87.7 |
| Mediatek |  |  |  |  | -67.6 |  | -87.8 |  |  |  | -67.6 |  | -88 |
| Qualcomm |  |  | -85.2 | -80.2 | -69.9 | -78.5 |  | -81.7 | -76.4 |  | -69.9 | -82.7 |  |
| Huawei | -90.1 |  | -86.1 | -82 | -71.5 |  |  |  |  |  | -71 |  |  |
| Apple |  |  |  |  |  | -76.7 |  |  |  |  |  | -77 |  |
| Skyworks | -90.1 | -87.1 | -87.5 | -85 | -70.6 |  | -85.1 | -86.1 | -81 | -84.4 | -71.6 |  | -85.5 |
| Average | -90.1 |  | -86.2 | -82.9 | -68.7 | -77.6 | -86 | -84.4 | -78.3 |  | -69.8 | -79.9 | -87 |

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| --- |
| UL Config (15 KHz SCS) |
| Company | n1 | n2 | n3 |  | n8 | n25 |  | n71 |
| 45 | 35 | 35 | 45 | 35 | 35 | 45 | 35 |
|  |  |  |  |  |  |  |  |  |
| Murata |  |  | 50 |  | 20 | 40 | 40 | 20 |
| Mediatek |  |  |  |  | 20 |  |  | 20 |
| Qualcomm |  |  | 50 |  | [20] | 45 | 40 | [20] |
| Huawei | 128 |  | 50 | 50 | 20 |  |  | 20 |
| Apple |  |  |  |  | 20 |  |  | 20 |
| Skyworks | 128 | 40 | 50 | 50 | 25 | 40 |  | 25 |

## Open issues summary

### Sub-topic 3-1

**Issue 3-1: n1 45MHz REFSENS**

* Proposals summary

See clause 3.1.

* Tentative agreements
* **Table 3.2.1-1: Two antenna port reference sensitivity QPSK PREFSENS**

| **Operating Band** | **SCS kHz** | **45****MHz(dBm)** |
| --- | --- | --- |
| n1 | 15 | -90.1 |
| 30 | [-90.2] |
| 60 | -90.3 |

* **Table 3.2.1-2: Uplink configuration**

| **Operating Band** | **SCS kHz** | **45****MHz** |
| --- | --- | --- |
| n1 | 15 | 1281 |
| 30 | 641 |
| 60 | 301 |

* Recommended WF
	+ Agree on reference sensitivity and UL configuration in Table 3.2.1-1 and Table 3.2.1-2.

### Sub-topic 3-2

**Issue 3-2: n3 35MHz and 45 MHz REFSENS**

* Proposals summary

See clause 3.1.

* Tentative agreements
* Table 3.2.2-1: Two Antenna Port Reference Sensitivity QPSK PREFSENS

| Operating Band | SCS kHz | 35 MHz(dBm) | 45 MHz(dBm) |
| --- | --- | --- | --- |
| n3 | 15 | [-86.2] | [TBD] |
| 30 | [-86.3] | [TBD] |
| 60 | [-86.4] | [TBD] |

* Table 3.2.2-2: Uplink Configuration for Reference Sensitivity

| Operating Band | SCS kHz | 35 MHz(dBm) | 45 MHz(dBm) |
| --- | --- | --- | --- |
| n3 | 15 | 501 | 501 |
| 30 | 241 | 241 |
| 60 | 101 | 101 |

* Recommended WF
	+ Agree on UL configuration in Table 3.2.2-2 and check whether the REFSENS in Table 3.2.2-1 is acceptable.

### Sub-topic 3-3

**Issue 3-3: n8 and n71 REFSENS**

* Proposals summary

See clause 3.1.

* Potential agreements
	+ Channel locations
		- Option 1: Worst case
		- Option 2: Middle case (centre)
		- Option 3: Worst case and best case
	+ Refsens

Table 3.2.3-1: Two Antenna Port Reference Sensitivity QPSK PREFSENS for n8 35MHz CBW.

| Operating Band | SCS kHz | **Channel bandwidth (DL)**(MHz) | **Channel bandwidth (UL)**(MHz) | **FC (DL)**(MHz) | **FC (UL)**(MHz) | **UL**allocation (LCRB) | REFSENS(dBm) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| n8 | 15 | 35 | 20 | 942.5 | 890.0 | 252 | [-86] |
| 30 | 102 | [-86.1] |
| 60 |  |  |
| n8 | 15 | 35 | 20 | 942.5 | 905.0 | 252 | [-68.7] |
| 30 | 102 | [-68.8] |
| 60 |  |  |

Table 3.2.3-2: Two Antenna Port Reference Sensitivity QPSK PREFSENS for n71 35MHz CBW.

| Operating Band | SCS kHz | **Channel bandwidth (DL)**(MHz) | **Channel bandwidth (UL)**(MHz) | **FC (DL)**(MHz) | **FC (UL)**(MHz) | **UL**allocation (LCRB) | REFSENS(dBm) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| n71 | 15 | 35 | 20 | 634.5 | 688.0 | 252 | [-87] |
| 30 | 102 | [-87.1] |
| 60 |  |  |
| n71 | 15 | 35 | 35 | 634.5 | 673.0 | 252 | [-69.8] |
| 30 | 102 | [-69.9] |
| 60 |  |  |

* Recommended WF
	+ Option 3 is recommended for UL channel locations
	+ Discussion on the above potential agreements and check whether the REFSENS in Table 3.2.3-1 and Table 3.2.3-2 are acceptable.

### Sub-topic 3-4

**Issue 3-4: n25 35MHz and 45MHz REFSENS**

* Proposals summary

See clause 3.1.

* Potential agreements
	+ Channel locations 40/45 MHz case
		- Option 1: Worst case
		- Option 2: Middle case (centre)
		- Option 3: Worst case and best case
	+ n25 Refsens

Table 3.2.4-1: Two Antenna Port Reference Sensitivity QPSK PREFSENS for n25 35 MHz

| Operating Band | SCS kHz | 35 MHz(dBm) |
| --- | --- | --- |
| n25 | 15 | [-84.4] |
| 30 | [-84.5] |
| 60 | [-84.6] |

Table 3.2.4-2: Uplink Configuration for Reference Sensitivity

| Operating Band | SCS kHz | 35 MHz(dBm) |
| --- | --- | --- |
| n25 | 15 | 401 |
| 30 | 201 |
| 60 | 101 |
|  |  |

Table 3.2.4-3: Two Antenna Port Reference Sensitivity QPSK PREFSENS for n25 35 MHz

| Operating Band | SCS kHz | **Channel bandwidth (DL)**(MHz) | **Channel bandwidth (UL)**(MHz) | **FC (DL)**(MHz) | **FC (UL)**(MHz) | **UL**allocation (LCRB) | REFSENS(dBm) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| n25 | 15 | 45 | 40 | 1972.5 | 1890.0 | 401 | TBD |
| 30 | 201 | TBD |
| 60 | 101 | TBD |
| n25 | 15 | 45 | 40 | 1972.5 | 1895.0 | 401 | [-78.3] |
| 30 | 201 | [-78.4] |
| 60 | 101 | [-78.5] |

* + n2 Refsens
		- further check on more inputs
* Recommended WF
	+ Option 3 is recommended for UL channel locations
	+ Discussion on the above potential agreements and check whether the REFSENS in Table 3.2.4-1~ Table 3.2.4-3 are acceptable.

### Sub-topic 3-5

**Issue 3-5: n2 and n25 A-MPR**

* Proposals
* A-MPR for NS\_03 35MHz CBW in R4-2100517,
* Table 3.2.5-1: A-MPR for NS\_03 35MHz CBW

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Channel BW | Carrier FrequencyFc | Waveform | Modulation | Outer | Inner |
| 35MHz | 1867.5<=Fc <= 1892.5 | DFT-s-OFDM | PI/2 BPSK | 2.5 | 0.5 |
| QPSK | 3.0 | 0.5 |
| 16QAM | 3.0 | 1.0 |
| 64QAM | 3.5 | 2.5 |
| 256QAM | 5.5 | 4.5 |
| CP-OFDM | QPSK | 4.5 | 2.0 |
| 16QAM | 4.5 | 2.5 |
| 64QAM | 4.5 | 3.5 |
| 256QAM | 7.5 | 6.5 |

* A-MPR for NS\_03 45MHz CBW in R4-2100518,
* Table 3.2.5-2: A-MPR regions for NS\_03 45MHz CBW

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel BW  | Carrier FrequencyFc | RBend\*12\*SCS (MHz) | LCRB\*12\*SCS (MHz) | A-MPR |
| 45 MHz | 1872.5<=Fc <= 1892.5 MHz | >=38.16 | >0 | A1 |
| >=19.44, <38.16 | >=15.48 | A2 |
| <19.44 | >=max(0,RB\_end\_Hz-3.96e6) | A3 |

* Table 3.2.5-3: A-MPR for NS\_03 45MHz CBW

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Waveform | Modulation | A1 | A2 | A3 |
| Outer / Inner | Outer / Inner | Outer / Inner |
| DFT-s-OFDM | PI/2 BPSK | 3.5 | 2.5 | 2.0 |
| QPSK | 4.0 | 3.0 | 2.5 |
| 16QAM | 4.5 | 3.0 | 3.0 |
| 64QAM | 4.5 | 3.5 | 3.5 |
| 256QAM | 5.5 | 5.5 | 5.5 |
| CP-OFDM | QPSK | 5.5 | 4.5 | 5.0 |
| 16QAM | 5.5 | 4.5 | 5.0 |
| 64QAM | 5.5 | 4.5 | 5.0 |
| 256QAM | 7.5 | 7.5 | 7.5 |

Note: in the WF approved in RAN4#97-e, the following tentative agreements were reached,

* + Agree on the updated NS\_03 requirement for 35MHz and 45MHz
	+ Agree to use same NS\_03 AMPR for 35MHz and 45MHz as specified in TS38.101-1
* Recommended WF
	+ TBD

### Sub-topic 3-6

**Issue 3-6: n1 A-MPR**

* Proposals
* A-MPR Regions for NS\_48 and NS\_49 in R4-2100517,
* Table 3.2.6-1: Regions for NS\_48

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel BW (MHz) | Carrier FrequencyFc (MHz) | RBend\*12\*SCS (MHz) | LCRB\*12\*SCS (MHz) | A-MPR |
| 45 | 1942.5 ≤ Fc ≤1957.5 | >=0, <5.76 | >0 | A2 |
| >=5.76, <19.44 | >=max(0,12\*RB\_end\*SCS-3.6) | A4 |
| >=5.76, <19.44 | <max(0,12\*RB\_end\*SCS-3.6)>=max(0,12\*RB\_end\*SCS-5.76) | A3 |
| >=19.44, <38.16 | >=14.4 | A2 |
| >=30.24, <38.16 | <1.08 | A5 |
| >=38.16 | >0 | A1 |

* Table 3.2.6-2: Regions for NS\_49

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel BW (MHz) | Carrier FrequencyFc (MHz) | RBend\*12\*SCS (MHz) | LCRB\*12\*SCS (MHz) | A-MPR |
| 45 | 1942.5 ≤ Fc ≤1957.5 | >=7.74, <14.4 | <max(0,RB\_end-7.74) | A5 |
| >=30.96, <35.28 | <1.08 | A5 |
| <35.28 | >=15.12<max(0,RB\_end-7.74) | A2 |
| <35.28 | <15.12>=11.52< max(0,RB\_end-7.74) | A3 |
| <35.28 | >=max(0,RB\_end-7.74) | A1 |
| >=35.28 | >0 | A1 |

* Recommended WF
	+ TBD

## Companies views’ collection for 1st round

### Open issues

**Issue 3-1: n1 45MHz REFSENS**

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| **Company** | **Comments** |
| China Telecom | -90.1dBm for 30kHz is more preferred. But we are ok to add the bracket to -90.2 as recommended by moderator. |
| Ericsson | One general comment on the REFSENS summary table in 3.1. The averaging of the input values from companies (in dBm) seems not to have been converted to mW (or Watt) before averaging. We would appreciate if that is done.We are fine with the suggested WF for n1 45MHz REFSENS |
| ZTE | -90.2dBm REFSEN requirement for 30kHz SCS can be used considering -90.1dBm REFSEN requirement for 15kHz SCS |
| Huawei | Ok with -90.2dBm for 30 KHz |
| Skyworks | For n1 45MHz REFSENS, we proposed -94.1dBm SCS30kHz but the actual value is closer to -94.1476dBm. So, we are fine with WF proposal. |
| Apple | We are okay with the WF |

**Issue 3-2: n3 35MHz and 45 MHz REFSENS**

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| **Company** | **Comments** |
| Ericsson | The same general comment as above for averaging. In this case the average for n3 is -86.124 rather than -86.2.Anyway we are ok with the suggested REFSENS table leaving values for 35MHz within brackets and keep 45MHz as TBD to get some overall progress. We agree on the UL configuration in table 3.2.2.2-2. |
| Skyworks | UL RB configuration table for 35MHz and 45MHz are agreeable. For REFSENS:n3 35MHz: At Lcrb=50 (SCS15), our measurements show that the PA output noise performance is dominated by the input RF signal source noise level. For 35MHz CBW, our MSD evaluation ranges from 0.3dB (PA intrisinc noise performance with ideal signal source) to 2dB if take full impact of signal source noise contribution. We propose a REFSENS level of -87.5dBm which corresponds to a 0.7dB MSD n3 45MHz: For 45MHz, our estimated MSD ranges from 1.4dB to 2.85dB, and we propose 2.04dB MSD with -85.1dBm REFSENS. We realize this is smaller than the 40MHz baseline MSD of 5.3dB. If we applied the 40MHz 5.3dB MSD to 45MHz CBW, REFSENS would be -81.8dBm SCS15. We are open to further discuss. |
| Apple | We are okay with the WF |
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**Issue 3-3: n8 and n71 REFSENS**

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| **Company** | **Comments** |
| Ericsson | Support option 3. |
| Qualcomm | QC cannot accept table values. Numbers quoted from contributions cannot be lower than the TXBW/RXBW = 20MHz/20MHz cases. QC only evaluated the mid-case duplex offset. After post-meeting deadline evaluation, Band, Best case, Mid Case, Worst Case for 20MHz/35MHzn8, -84.8, -78.5, -70.7n71, -84.9, -82.7, -71.2 |
| Huawei  | Support option 3 on channel locations |
| Skyworks | We provided best and worst case REFSENS for both bands according to WF agreement. We note however 1) To take full advantage of a low band link budget, the most likely scenario for the few operators who have full band bandwidth holdings is that of configuring the uplink carrier that minimizes the DL MSD, 2) Considering the expansion of the number of REFSENS and MSD test points, it is desirable to retain the most relevant test points for the sake of test time and test cost reduction.We would therefore like to consider option 4 which consists in specifying only the REFSENS test point that corresponds to the best case scenario:n8= -85.1 dBm, n71=-85.5dBm. We are open to further discuss. |
| MediaTek | In terms of #97e WF consensus and Channel location option, we prefer option 3 since it provides upper bound (worst case) and lower bound (best case) performance verification. However, with new consideration about test-cost impact, we wonder whether option 2 may also be considered. We think option 1 (worst-case) provides better characterization of IM3 and CIM5 impacts. But if worst-case measurement will be removed and resolving test cost is consensus after discussion, we would like to consider option 2 and option 4 and are open to further discuss.In terms of worst-case REFSENS, we are fine with Moderator’s table values. And regarding best-case REFSENS and Qcom’s consideration, we are open to further discuss. |
| Apple | Option 2. Like for other REFSENS requirements, we prefer to have just one test point. The REFSENS will be used in many other Rx requirements as reference for wanted signal power. Having two requirements will increase the test load substantially. In our view having two test cases here does not really benefit the test coverage. |

**Issue 3-4: n25 35MHz and 45MHz REFSENS**

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| **Company** | **Comments** |
| Ericsson | Support option 3. Comment on averaging: Linear averaging is -77.86 compared to -78.3 |
| Qualcomm | Best case numbers quoted from contributions cannot be lower than the TXBW/RXBW = 40MHz/40MHz cases. QC only evaluated the mid-case duplex offset. After post-meeting deadline evaluation,Band, Best case, Mid Case, Worst Case for 40MHz/45MHzn25, -79.4, -76.4, -72 |
| Huawei  | Support option 3 on channel locations |
| Skyworks | 35MHz REFSENS: we realize that our REFSENS proposal corresponds to an MSD level which is lower than the baseline agreement for 30MHz. We note this is also the case for all proposed REFSENS values, including the summary table dB average of -84.4dBm. If we were to adopt the 30MHz MSD level, the REFSENS for SCS15 would be approximately -81.5dBm.45MHz: Situation different that n8/n71. Option 3. For best case, it is difficult to discuss considering there are only 2 proposals. For worst case, our proposal is below the 40MHz agreed MSD. If we were to adopt 40MHz CBW MSD, 40/45 worst case REFSENS would be -79dBm. We are open to discuss this value. |
| Apple | Option 2. Like for other REFSENS requirements, we prefer to have just one test point. The REFSENS will be used in many other Rx requirements as reference for wanted signal power. Having two requirements will increase the test load substantially. In our view having two test cases here does not really benefit the test coverage. |
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**Issue 3-5: n2 and n25 A-MPR**

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| **Company** | **Comments** |
| Qualcomm | There was an agreement last meeting for no additional AMPR for NS\_03. Does Apple expect NS\_03 AMPR to be worse at 35, 40, 45MHz channel BWs than the lower channel BWs? |
| AT&T | Agree with QC that there should be no additional A-MPR for NS\_03 and A-MPR for 35 MHz should follow proposal in R4-2102166 which highlights that A-MPR for NS\_03 is CBW agnostic and proposes no additional A-MPR requirements for n2 for 30 MHz and 40 MHz. Same proposal should hold for 35 MHz. |
| Apple | The simulations were done due to a misunderstanding of WF in R4-2016863 on Slide 15. The increased power backoff comes from the coexistence requirements of n2 and n25. If Rx of band 70 has to be protected with -50dBm/MHz without any filter rejection, then additional power backoff is required to keep emission limits. This results into the increased A-MPR need, especially for 45MHz CBW.  |
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**Issue 3-6: n1 A-MPR**

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| **Company** | **Comments** |
| China Telecom  | Thanks for the inputs on the a-mpr simulations for Band n1. In general we are fine with the regions assignment and corresponding a-mpr values. The a-mpr values for 45MHz seemingly have a little bit improvement by comparing to the cases for 50MHz. Just wonder if there are any other updates or inputs for double check on this requirement?  |
| Qualcomm | We did not know that 35MHz and 45MHz were agreed channel BWs for n1. If this is an agreement, then we need to push to next meeting to analyze results and verify region thresholds. |
| Huawei | It should be ok to leave the decision to next meeting since 45 MHz is just required in last RAN#90 for n1. |
| Apple | We can definitely postpone decision to next meeting. |
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## 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 3-1: n1 45MHz REFSENS | * Tentative agreements
* Reference sensitivity and UL configuration in Table 3.2.1-1 and Table 3.2.1-2

Recommendations for 2nd round: agree on the tentative agreements above and capture the agreements in WF2. |
| Issue 3-2: n3 35MHz and 45 MHz REFSENS | * Tentative agreements
* UL configuration in Table 3.2.2-2

Recommendations for 2nd round: Agree on the UL configuration and check further agreement on REFSENS, and capture the agreements in WF2. |
| Issue 3-3: n8 and n71 REFSENS | Based on the 1st round discussion, the options are divided on channel locations which need further discussion at 2nd round. When the channel location is decided, we discuss the REFSENS values.Recommendations for 2nd round: further discussion on channel location and check further agreement on REFSENS, and capture the agreements in WF2 |
| Issue 3-4: n25 35MHz and 45MHz REFSENS | Based on the 1st round discussion, the options are divided on channel locations which need further discussion at 2nd round. When the channel location is decided, we discuss the REFSENS values.Recommendations for 2nd round: further discussion on channel location and check further agreement on REFSENS, and capture the agreements in WF2 |
| Issue 3-5: n2 and n25 A-MPR | There was an agreement last meeting that no additional AMPR for NS\_03. Further discussion is needed on whether additional power backoff is required for protection of band 70 RX.Recommendations for 2nd round: further discussion on whether additional power backoff is required, and capture the agreements in WF3 |
| Issue 3-6: n1 A-MPR | Based on 1st round discussion, companies are ok to postpone the decision to next meetingRecommendations for 2nd round: no further discussion at 2nd round, and capture the work plan in WF3 |

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| WF2 | WF on REFSENS for 35MHz and 45MHz | Qualcomm |
| WF3 | WF on A-MPR for 35MHz and 45MHz | Apple |

## Discussion on 2nd round (if applicable)

R4-2103187 Way forward on REFSENS for 35MHz and 45MHz

Source: Qualcomm

R4-2103188 Way forward on A-MPR for 35MHz and 45MHz

Source: Apple

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| **WF number** | **Comments collection** |
| Draft R4-2103187 |  |
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| Draft R4-2103188 |  |
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## 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*

# Topic #4: UE CRs

## Companies’ contributions summary

|  |  |  |
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| **T-doc number** | **Company** | **Title** |
| R4-2101503 | Huawei, HiSilicon | CR for TS 38.101: introduction of channel bandwidths 35MHz and 45MHz |
| R4-2102193 | ZTE Corporation | Introduction of 35MHz and 45 MHz bandwidths to TS38.101-1 |
| R4-2102606 | Apple | CR for TS 38.101-1: UE RF requirements table simplification |

## Companies views’ collection for 1st round

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| R4-2101503 | Ericsson: If this draft CR is to become a “real” CR the cover sheet needs some minor updates. The cover sheet version is v12.0 instead of v12.1.The title of the CR is slightly misleading stating that it’s an update to the general part of 38.101-1The inserted text in some tables in clause 5 have different font sizes in the head rowUpdated in Table 6.2.3.1-1 looks strange, has an extra comma.The Text Styles are not correct for newly introduced tables. E.g. First row should be TAH In Table 5.3.5-1 update to n3 and n25 and n71 is missingClaus 6.3.1 minimum output pwr is missingNo changes found in Table 7.3.2-1 REFSENSNo changes found in Table 7.3.2-3“Old” Table 7.8.2-1 remains in the CRQualcomm: Needs additional work to update REFSENS values. Place square brackets to the agreed upon values, is any. |
| ZTE: Similar CR from us. According to the issue above, it seems the RF requirements for some bands cannot be completed in this meeting. We need to pick up completed band(s) to complete the CR. In addition, we think "Table 7.4-1: Maximum input level" need to adopt the same approach as other requirements, i.e. table simplification by formulation. |
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| R4-2102193 | Ericsson: Editorial comments: The removed tables in Clauses 7.5, 7.6.2, 7.6.4, 7.7, 7.8 still remains as empty in the CR if change marks are accepted. |
| Qualcomm: Need to populate FFS values. Even minimum power can be further simplified. |
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| R4-2102606 | Ericsson: Overlapping (partly) with R4-2102193 and R4-2101503 |
| Qualcomm: Need to add 35MHz, 45MHz in the SEM mask tables. |
| ZTE: We understand this CR aims to simply the tables based on the agreements in last meeting, but without new added 35-45MHz. Actually we have already reflect the new table format in 2193. |
| Apple: Thanks for Ericsson, Qualcomm, and ZTE’s comments. The intention of this CR is to agree on the simplified and editing friendly UE RF requirements tables in the Rel-17 specifications first to prepare for the introduction of 35MHz/45MHz when their requirements are finalized. Therefore, 35MHz and 45MHz are intentionally left out. We are fine to merge our CR into either one of the above two CRs if they are more complete and agreeable in this meeting. However, if the above two CRs are only to be technically endorsed for some part of the contents, we still suggest to agree on this CR first in this meeting so that the new UE RF requirements table format is ready for the official 35MHz/45MHz CR in next meeting. By separating the table reformatting CR and 35MHz/45MHz CR would facilitate the 35MHz/45MHz CR review process and make it easier to focus on the technical contents later. |
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## Summary for 1st round

### CRs/TPs

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

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| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| 38.101-1 CR | Based on the discussion in Issue 1-1, it is proposed to technical endorse the CR for the band(s) which the requirements are finalized in this meeting. Moderator’s suggestion for 2nd round: the 3 CRs are merged to a running CR |
| R4-2101503 | *To be noted* |
| R4-2102193(ZTE) | *To be revised* |
| R4-2102606 | *To be noted* |
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## Discussion on 2nd round (if applicable)

R4-2103189 Introduction of 35MHz and 45 MHz bandwidths to TS38.101-1
Source: ZTE Corporation

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| **Company** | **Comments** |
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## Summary on 2nd round (if applicable)

# Topic #4: BS CRs

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2101504 | Huawei, HiSilicon | CR for TS 38.104: introduction of channel bandwidths 35MHz and 45MHz |
| R4-2101505 | Huawei, HiSilicon | CR for TS 37.141: introduction of channel bandwidths 35MHz and 45MHz |
| R4-2101506 | Huawei, HiSilicon | CR for TS 37.145-2: introduction of channel bandwidths 35MHz and 45MHz |
| R4-2101559 | Ericsson | CR to TS 37.105: Introduction of CBWs 35 MHz and 45 MHz |
| R4-2101560 | Ericsson | CR to TS 38.141-1: Introduction of CBWs 35 MHz and 45 MHz |
| R4-2101986 | ZTE Corporation | CR to TS 38.141-2: Introduction of 35MHz and 45MHz |
| R4-2101987 | ZTE Corporation | CR to 37.145-1: Introduction of 35MHz and 45MHz |
| R4-2102484 | Nokia, Nokia Shanghai Bell | CR to 37.104: Introduction of requirements for 35 and 45MHz channel bandwidths |

## Companies views’ collection for 1st round

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| R4-2101504 | Ericsson: Level of wanted signal on table 7.3.2-1 differs from conformance spec 38.141-1 CR in (R4-2101560) from Ericsson. The difference is small but should be aligned for consistency. We are fine to update our CR.Same comment for table 7.3.5-2 |
| ZTE: postpone the discussion to 2nd round as SU is still under discussion  |
| Huawei: to Ericsson, the difference comes from TT is added for test requirements.  |
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| R4-2101505 | ZTE: postpone the discussion to 2nd round as SU is still under discussion  |
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| R4-2101506 | ZTE: postpone the discussion to 2nd round as SU is still under discussion  |
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| R4-2101559 | ZTE: postpone the discussion to 2nd round as SU is still under discussion  |
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| R4-2101560 | ZTE: postpone the discussion to 2nd round as SU is still under discussion  |
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| R4-2101986 | ZTE: postpone the discussion to 2nd round as SU is still under discussion  |
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| R4-2101987 | ZTE: postpone the discussion to 2nd round as SU is still under discussion  |
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| R4-2102484 | ZTE: postpone the discussion to 2nd round as SU is still under discussion  |
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## Summary for 1st round

### CRs/TPs

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

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| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| BS CRs | Based on the discussion in Issue 1-1, it is proposed to technical endorse the CR for the band(s) which the requirements are finalized in this meeting. Moderator’s suggestion for 2nd round: return to all the BS CRs |
| R4-2101504 | *To be revised* |
| R4-2101505 | *To be revised* |
| R4-2101506 | *To be revised* |
| R4-2101559 | *To be revised* |
| R4-2101560 | *To be revised* |
| R4-2101986 | *To be revised* |
| R4-2101987 | *To be revised* |
| R4-2102484 | *To be revised* |
|  |  |

## Discussion on 2nd round (if applicable)

R4-2103190 CR for TS 38.104: introduction of channel bandwidths 35MHz and 45MHz

Source: Huawei, HiSilicon

R4-2103191 CR for TS 37.141: introduction of channel bandwidths 35MHz and 45MHz

Source: Huawei, HiSilicon

R4-2103192 CR for TS 37.145-2: introduction of channel bandwidths 35MHz and 45MHz
Source: Huawei, HiSilicon

R4-2103193 CR to TS 37.105: Introduction of CBWs 35 MHz and 45 MHz

Source: Ericsson

R4-2103194 CR to TS 38.141-1: Introduction of CBWs 35 MHz and 45 MHz

Source: Ericsson

R4-2103195 CR to TS 38.141-2: Introduction of 35MHz and 45MHz

Source: ZTE Corporation

R4-2103196 CR to 37.145-1: Introduction of 35MHz and 45MHz

Source: ZTE Corporation

R4-2103197 CR to 37.104: Introduction of requirements for 35 and 45MHz channel bandwidths

Source: Nokia, Nokia Shanghai Bell

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| **CR** | **Comments collection** |
| Draft R4-2103190  |  |
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## 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*