**3GPP TSG-RAN WG4 Meeting # 97-e R4-2016627**

Electronic Meeting, 2-13 Nov., 2020

**Agenda item:** 10.22

**Source:** Moderator (Huawei)

**Title:** Email discussion summary for [97e][125] NR\_FR1\_35MHz\_45MHz\_BW

**Document for:** Information

# Introduction

The scope of this email discussion is to discuss the contributions submitted at agenda 10.22 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: Release independence
* Topic#2: Spectrum utilization
* Topic#3: UE RF requirements
  + Sub-topic 3-1: Expanding Specification Tables
  + Sub-topic 3-2: UL BW limitation
  + Sub-topic 3-3: new BW handling
  + Sub-topic 3-4: n3 35MHz and 45MHz REFSENS
  + Sub-topic 3-5: n8 35MHz REFSENS
  + Sub-topic 3-6: n25 35MHz and 45 MHz REFSENS
  + Sub-topic 3-7: n71 35MHz REFSENS
  + Sub-topic 3-8: n7 35 MHz A-MPR
  + Sub-topic 3-9: n25 and n66 A-MPR
  + Sub-topic 3-10: n71 35 MHz A-MPR
* Topic #4: UE draft CRs
* Topic#5: BS draft CRs

# Topic #1: General part

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2015351 | OPPO | Proposal 1: Option 3: Release independence shall be discussed cases by case per band and bandwidths |
| R4-2015701 | Huawei, HiSilicon | The paper provide the needed changes to TS 38.307 for the options. |
| R4-2016113 | ZTE Corporation | Observation: if 35MHz/45MHz is introduced in release independent way from earlier release, there might be potential NBC issues if the existing maximum supported channel bandwidth is less than 35MHz/45MHz.  Proposal 1: sent LS to RAN2 to inform the introduction of 35MHz and 45MHz from Rel-17 onwards.  Proposal 2: to explicit inform RAN2 that 35MHz/45MHz might be maximum channel bandwidth in certain bands; |
| R4-2016452 | T-Mobile USA, TELUS, Bell Mobility, AT&T | Observation 1: RAN2 has allocated spare bits in Rel-15 for adding new channel BWs to UE capabilities.  Observation 2: A RAN2 CR shows how to add 35 and 45 MHz UE capability signalling to Rel-15.  Observation 3: There is no protocol reason to not make 35 and 45 MHz release independent to Rel-15.  Observation 4: Having the new Channel BWs release independent to RTel-15 won’t cause any backward compatibility issues.  Proposal 1: RAN4 should agree to make the new 35 and 45 MHz channel BWs release independent to Rel-15, and leave the topic of release implementation to commercial rather than standards discussions. |
| R4-2015800 (Proposal 3) | Skyworks Solutions Inc. | • Release independence for band/band combination should be agreed case by case. |

## Open issues summary

### Sub-topic 1-1

**Issue 1-1: Release independence**

* Proposals
  + Option 1: The support of 35 MHz and 45 MHz is from Rel-17 onwards
  + Option 2: 35 MHz and 45 MHz is optional support from Rel-15
  + Option 3: Release independence shall be discussed cases by case per band and bandwidths.
* Recommended WF
  + It is proposed to continuously discuss the 3 options and make a decision this meeting, considering the following aspects,
    - UE signaling
    - UE hardware capability
    - backward compatibility issues
    - band specific work

## Companies views’ collection for 1st round

### Open issues

**Comments on Release independence**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | We support option 1 as this bandwidth demand is clearly from Rel-17, in addition, we could see lots of implementation efforts needed for the support of 35/45MHz, this could be treated as NBC issue. We have concerns on option 2 as this will increase BS implementation uncertainty whether to support such kind of feature due to uncertainty of UE feature. |
| Huawei | We are open on the options. We have one clarification question on R4-2015800. It propose to discuss release independence cases by case. While in R4-2015800 table 1 in clause 2.2, for all the cases it states Rel indep from R16 min. Does it mean option 3 is optional support from Rel-16? |
| Ericsson | We support the proposal in R4-2016452. |
| Qualcomm | Support for 35M, 45M BWs should not be mandatory for earlier release. It seems there is existing capability for this after checking with RAN2 colleague. We can further check if this is true for all bands mentioned in this thread as well as check that enough bits are available for BWs added in the future. |
| Skyworks | We support option 3 and would be willing to discuss cases by case if it can be before R17. But we could also agree with R17 for the cases where the 35MHz and/or 45MHz does not become the widest BW supported (especially in UL). For the cases where 35MHz and/or 45MHz becomes the highest BW one option is to have optional support from R17. Still we also need to agree whether these BW become a generic channel BW for any band which we don’t think is necessary and would result into a lot of effort in 3GPP |
| T-Mobile USA | We support Option 2 as described in R4-2016452. We agree with Qualcomm that these new channel BWs should be optional in Rel-15 and Rel-16. However, we don’t think that it is necessary to take up RAN4 meeting time to discuss release independence on a case by case basis. We think it is important to separate the protocol aspects from the business-related implementation timelines. We think the new channel BWs could be added to the available BWs for a given band based on operator requests, just like any other channel BW.  As for the 4 aspect:  **UE Signalling:** RAN2 reserved spare bits for new channel BWs in Rel-15 as shown in the CR in R2-2007212, so there should be no signalling issues.  **UE hardware capability:** These new channel BWs would be optional in Rel-15 and Rel-16, so there shouldn’t be standards related hardware capabilities issues. The hardware issues can be addressed in commercial implementation plans.  **Backward compatibility issues:** There are no backward compatibility issues. If the network supports a new channel BW that the UE does not support, it will be the same as any other channel BW that the UE does not support. If the UE supports the channel BW but the network does not, the network will ignore the capability bits.  **Band specific work:**  There will be band specific work, but that needs to be addressed on a band by band basis. It shouldn’t impact the release independence. |
| Nokia | Support Option 2. It is feasible to make them release independent from Rel-15 without NBC issue. |
| AT&T | We support option 2. We agree with T-Mobile that new channel BWs can be added for a given band based on operator requests and that the technical band-specific work would be addressed as the new channel BW is introduced. Release independence should not be impacted. |
| Apple | Option 1 is our preference. But we are also open for release independence to earlier releases provided the support in earlier releases is not mandatory. |
| Bell Mobility | We support Option 2 and agree with T-Mobile and AT&T. |
| TELUS | Support Option 2 and agree with the proponents of this option. |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| Issue 1-1: Release independence | Based on the 1st round comments, option 2 has more supporting companies. It seems companies all agree that these new channel BW should not be mandatory for earlier release. However there are still different view on release independence among companies.  Option 1: ZTE, Apple  Option 2: Ericsson, T-Mobile USA, Nokia, AT&T, Bell Mobility, TELUS  Option 3: Skyworks, OPPO  Recommendations for 2nd round: further discussion on the options and capture the potential agreements in the WF |
|  |  |
|  |  |
|  |  |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| WF1 | WF on release independence for 35 MHz and 45 MHz | T-Mobile USA |

### 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)

|  |  |
| --- | --- |
| **WF number** | **Comments collection** |
|  |  |
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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 #2: Spectrum utilization

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2015043 | 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 | |

## Open issues summary

### Sub-topic 2-1

**Issue 2-1: 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 spectrum utilization**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | We support the recommended WF. |
| Huawei | We agree |
| Qualcomm | Agree to remove square brackets |
| Skyworks | Agree with SU without brackets |
| Nokia | We should keep square bracket until next meeting in case possible issues may be found, for example, due to the alignment with the legacy channel bandwidths. |
| Apple | We agree to remove square brackets. |
| Huawei | The A-MPR simulation is related to the SU. Our preference is to remove the square brackets. |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| Issue 2-1: Spectrum utilization | Based on 1st round discussion, all companies agree to remove square brackets except that Nokia want to keep square bracket until next meeting. It is also recognized that some work are related to SU which should be decided ASAP.  Recommendations for 2nd round: Agree with the SU without brackets unless some issues for current SU are identified in the 2nd round. It is proposed to return to R4-2015043. |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

# Topic #3: UE RF requirements

## Companies’ contributions

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Title** |
| R4-2014173 revised to R4-2016600 | Qualcomm Incorporated | 35M\_45M AMPR, MPR, REFSENS |
| R4-2015432 | Murata Manufacturing Co Ltd. | REFSENS of n3, n8, n25 and n71 for new channel bandwidth |
| R4-2015800 | Skyworks Solutions Inc. | Specification impact of additional 35&45MHz channel bandwidths |
| R4-2016010 | Skyworks Solutions Inc. | n71 35MHz AMPR and MSD Measurements |
| R4-2016011 | Skyworks Solutions Inc. | n8 35MHz AMPR and MSD Measurements |
| R4-2016027 | Skyworks Solutions Inc. | n7 35MHz AMPR and MSD Measurements |
| R4-2016060 | Ericsson | Introduction of 35MHz and 45MHz regarding CA, DC, V2x combinations |
| R4-2016295 | Apple Inc. | Introduction of 35 MHz for n8, n66, n71 and 45 MHz for n66 |
| R4-2014186 | MediaTek Inc. | REFSENS of n8 and n71 for 35MHz channel bandwidth |
| R4-2014911 | Apple Inc. | UE RF requirements tables with channel BW dependency |

## Open issues summary

### Sub-topic 3-1

**Issue 3-1: Expanding Specification Tables**

* Proposals

**Proposal 1:** SEM, ACS, In-band and Narrow band blocking, Spurious response, Intermodulation tables use equations proportional to channel BW instead of one column per channel BW.

**Observation:** There are many other specification tables that have one column per channel BW such as channel configurations for single CC and band combinations and the related REFSENS and RFSENS exceptions. Simplification or a separate table may be needed.

* Recommended WF
  + Check whether proposal 1 above is agreeable

### Sub-topic 3-2

**Issue 3-2: UL BW limitation**

* Proposals
* UL BW limitation to 20 MHz for n8 and n71 should seriously be considered as default operation to guarantee the best DL operation in 35 MHz and reduce spec/test impact.
* UL BW limitation to 40 MHz for n25 could be further studied if justified from an MSD point of view
* Recommended WF
  + To discuss whether UL BW limitation is adopted for the case with high MSD in DL

### Sub-topic 3-3

**Issue 3-3: new BW handling**

* Proposals

In R4-2015800

* Support of 35 and 45 MHz Channel bandwidth should be optional for bands and should use separate table for band and band specific requirements. This should apply to any new FR1 channel BW beyond Release 16.
* The introduction of new “regular” channel bandwidth or new bands using these channel bandwidths, should not be treated with a basket approach including for band combinations.

In R4-2016060

* Proposal 1: RAN4 shall avoid adding new BCSs when introducing new bandwidths to band combinations, if really needed it should be done on a case by case basis.
* Recommended WF
  + Comments on the proposals

### Sub-topic 3-4

**Issue 3-4: n3 35MHz and 45MHz REFSENS**

* Proposals summary

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Operating Band** | **SCS kHz** | **35 MHz (dBm)** | | | **45 MHz (dBm)** | | | **Duplex Mode** |
|
|
|  |  | **Murata** | **Qualcomm** |  | **Murata** | **Qualcomm** |  |  |
| n3 | 15 | -86 | -85.2 |  | -84.2 | -80.2 |  | FDD |
| 30 | -86.1 |  |  | -84.3 |  |  |
| 60 | -86.2 |  |  | -84.4 |  |  |
|  |  |  |  |  |  |  |  |  |
| **Operating Band** | **SCS kHz** | **35 MHz (dBm)** | | | **45 MHz (dBm)** | | | **Duplex Mode** |
|
|
|  |  | **Murata** | **Qualcomm** |  | **Murata** | **Qualcomm** |  |  |
| n3 | 15 | 50 | 50 |  | 50 | 50 |  | FDD |
| 30 | 24 |  |  | 24 |  |  |
| 60 | 10 |  |  | 10 |  |  |

* Tentative agreements
  + For n3 35MHz and 45MHz UL configuration, 50RB is used for 15 KHz SCS, 24RB is used for 30 KHz SCS, and10RB is used for 60 KHz SCS
* Recommended WF
  + Agree on the UL configuration and check if companies can agree on the MSD

### Sub-topic 3-5

**Issue 3-5: n8 35MHz REFSENS**

* Proposals summary

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Operating Band** | **SCS kHz** | **35 MHz (dBm)** | | | | | **Duplex Mode** |
|
|
| n8 |  | **Murata R4-2015432** | **Qualcomm R4-2014173** | **Skyworks R4-2016011** | **Apple R4-2016295** | **MediaTek R4-2014186** |  |
| 15 | -62.2 | -69.9 (Rbend =187) -84.0 (Rbend =143) -87.9 (Rbend =123) | -66.3 | -62.3 | -69.2 | FDD |
| 30 | -62.3 |  | -66.4 | -63,7 | -69.5 |
| 60 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| **Operating Band** | **SCS kHz** | **35 MHz (dBm)** | | | | | **Duplex Mode** |
|
|
| n8 |  | **Murata R4-2015432** | **Qualcomm R4-2014173** | **Skyworks R4-2016011** | **Apple R4-2016295** | **MediaTek R4-2014186** |  |
| 15 | 20 | 16 | 25 | 8 | 20 | FDD |
| 30 | 10 |  | 10 | 4 | 10 |
| 60 |  |  |  |  |  |

* Tentative agreements
* Recommended WF
  + Agree on UL configuration firstly and check if companies can get agreement on MSD

### Sub-topic 3-6

**Issue 3-6: n25 35MHz and 45 MHz REFSENS**

* Proposals summary

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Operating Band** | **SCS kHz** | **35 MHz (dBm)** | | | **45 MHz (dBm)** | | | **Duplex Mode** |
|
|
|  |  | **Murata R4-2015432** | **Qualcomm R4-2014173** |  | **Murata R4-2015432** | **Qualcomm** **R4-2016600** |  |  |
| n25 | 15 | -85.4 | -81.7 |  | -70.7 | -68. |  | FDD |
| 30 | -85.5 |  |  | -70.8 |  |  |
| 60 | -85.6 |  |  | -70.9 |  |  |
|  |  |  |  |  |  |  |  |  |
| **Operating Band** | **SCS kHz** | **35 MHz (dBm)** | | | **45 MHz (dBm)** | | | **Duplex Mode** |
|
|
|  |  | **Murata R4-2015432** | **Qualcomm R4-2014173** |  | **Murata R4-2015432** | **Qualcomm R4-2016600** |  |  |
| n25 | 15 | 40 | 45 |  | 40 | 40 |  | FDD |
| 30 | 20 |  |  | 20 |  |  |
| 60 | 10 |  |  | 10 |  |  |

* Tentative agreements
* Recommended WF
  + Agree on UL configuration firstly and check if companies can get agreement on MSD

### Sub-topic 3-7

**Issue 3-7: n71 35MHz REFSENS**

* Proposals summary

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Operating Band** | **SCS kHz** | **35 MHz (dBm)** | | | | | **Duplex Mode** |
|
|
|  |  | **Murata R4-2015432** | **Qualcomm R4-2014173** | **Skyworks R4-2016010** | **Apple R4-2016295** | **MediaTek R4-2014186** |  |
| n71 | 15 | -67.6 | 69.9 | -66.5 | -62.5 | -70.5 | FDD |
| 30 | -67.7 |  | -66.6 | -63.9 | -70.8 |
| 60 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| **Operating Band** | **SCS kHz** | **35 MHz** | | | | | **Duplex Mode** |
|
|
|  |  | **Murata R4-2015432** | **Qualcomm R4-2014173** | **Skyworks R4-2016010** | **Apple R4-2016295** | **MediaTek R4-2014186** |  |
| n71 | 15 | 20 | 16 | 25 | 8 | 20 | FDD |
| 30 | 10 |  | 10 | 4 | 10 |
| 60 |  |  |  |  |  |

* Tentative agreements
* Recommended WF
  + Agree on UL configuration firstly and check if companies can get agreement on MSD

### Sub-topic 3-8

**Issue 3-8: n7 35 MHz A-MPR**

* Proposals
* A-MPR regions for in R4-2014173,

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channel Bandwidth, MHz** | **Carrier Center Frequency, Fc, MHz** | **Regions** | | **A-MPR** |
| **RBend\*12\*SCS** | **LCRB\*12\*SCS** |
| **MHz** | **MHz** |
| 35 MHz | 2517.5 ≤ FC ≤ 2552.5 | ≥0, <2.7 | >0 | A4 |
| ≥2.7, <13.5 | >max (0, 12\*SCS\*RBend –2.7) | A5 |
| ≥13.5, <23.76 | >9.0 | A6 |
| ≥23.76, <29.52 | >9.0 | A7 |
| ≥29.52 | >0 | A8 |

* A-MPR regions for in R4-2016027,

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel Bandwidth, MHz | Carrier Center Frequency, Fc, MHz | Regions | | A-MPR |
| RBend\*12\*SCS  MHz | LCRB\*12\*SCS  MHz |
| 35 MHz | 2517.5 ≤ FC ≤ 2552.5 | ≥0, <[2.7] | >0 | A4 |
| ≥[2.7], <[15.84] | >max (0, 12\*SCS\*RBend –[3.06]) | A5 |
| ≥[15.84], <[22.68] | >[12.6] | A6 |
| ≥[22.68], <[28.8] | >[9.36] | A7 |
| ≥[28.8] | >0 | A8 |

* Recommended WF
  + The A-MPR value for NS\_46 can be reused and check if companies can get agreement on A-MPR regions.

### Sub-topic 3-9

**Issue 3-9: n25 and n66 A-MPR**

* Proposals
* in R4-2014173,

Updated NS\_03 requirement below:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ΔfOOB**  **MHz** | **Channel bandwidth (MHz) / Spectrum emission limit (dBm)** | | | | | | | | | **Measurement bandwidth** |
| **5** | **10** | **15** | **20** | **25** | **30** | **35** | **40** | **45** |
|  0-1 | -13 | -13 | -13 | -13 | -13 | -13 | -13 | -13 | -13 | 1 % of channel BW |
|  1-6 | -13 | -13 | -13 | -13 | -13 | -13 | -13 | -13 | -13 | 1 MHz |
|  6-10 | -25 | -13 | -13 | -13 | -13 | -13 | -13 | -13 | -13 | 1 MHz |
|  10-15 |  | -25 | -13 | -13 | -13 | -13 | -13 | -13 | -13 | 1 MHz |
|  15-20 |  |  | -25 | -13 | -13 | -13 | -13 | -13 | -13 | 1 MHz |
|  20-25 |  |  |  | -25 | -13 | -13 | -13 | -13 | -13 | 1 MHz |
|  25-30 |  |  |  |  | -25 | -13 | -13 | -13 | -13 | 1 MHz |
|  30-35 |  |  |  |  |  | -25 | -13 | -13 | -13 | 1 MHz |
|  35-40 |  |  |  |  |  |  | -25 | -13 | -13 | 1 MHz |
|  40-45 |  |  |  |  |  |  |  | -25 | -13 | 1 MHz |
|  45-50 |  |  |  |  |  |  |  |  | -25 | 1 MHz |

**Proposal 2**: Use same NS\_03 AMPR for 35MHz and 45MHz as specified in TS38.101-1.

* in R4-2016295,

**Observation 4**: Band n66 Tx with 45MHz CBW and NS\_43&NS\_43U does not seem to require additional power reduction for CP-OFDM QPSK to comply with emission requirements.

* Recommended WF
  + 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

### Sub-topic 3-10

**Issue 3-10: n71 35 MHz A-MPR**

* Proposals
* in R4-2014173,

SEM requirements for NS\_35

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **ΔfOOB  (MHz)** | **Channel bandwidth (MHz) / Spectrum emission limit (dBm)** | | | | | | **Measurement bandwidth** |
| **5** | | **10** | **15** | **20** | **35** |
|  0-0.1 | -15 | | -18 | -20 | -21 | -23.5 | 30 kHz |
|  0.1-6 | -13 | | -13 | -13 | -13 | -13 | 100 kHz |
|  6-10 | -251 | | -13 | -13 | -13 | -13 | 100 kHz |
|  10-15 |  | | -251 | -13 | -13 | -13 | 100 kHz |
|  15-20 |  | |  | -251 | -13 | -13 | 100 kHz |
|  20-25 |  | |  |  | -251 | -13 | 100 kHz |
|  25-35 |  | |  |  |  | -13 | 100 kHz |
|  35-40 |  | |  |  |  | -25 | 1 MHz |
|  | | NOTE 1: The measurement bandwidth shall be 1 MHz | | | | | |

**Observation 1**: Further measurement study is required to determine the 35MHz NS\_35 AMPR impact.

* In R4-2016295,

**Observation 3**: Band n71 Tx with 35MHz CBW and filter rejection of 9dB in protected region requires additional power reduction of roughly 10dB for CP-OFDM QPSK to comply with coexistence requirements.

**Proposal 5:** RAN4 needs to consider either introducing additional power back off for n71 with 35MHz or the usage of asymmetric UL/DL.

* Recommended WF
  + Agree on the SEM requirements for NS\_35
  + Further discussion on the approach for protection close 3GPP bands
  + Further study on the required A-MPR for NS\_35

## Companies views’ collection for 1st round

### Open issues

**Issue 3-1: Expanding Specification Tables**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Thanks to the good idea by using equations proportional to channel BW. But currently we still think using one column per channel BW is more straightforward (i.e. current way). |
| Huawei | It will change the existing table for other channel bandwidth and not sure if it need to be discussed in TEI. |
| Ericsson | Interesting idea with an equation, there is a risk of reduced readability/understanding though. Would be good to see an example before any agreement. Maybe this is a larger discussion than to be agreed and implemented as part of this WI. |
| Qualcomm | I think WF is a good idea to at least study to reduce complexity of table using formula-based approach for specifications. Many new intermediary BWs could be added in the future |
| Skyworks | We support an equations based approach like described in R4-2014911 wherever feasible (possibly additional SEM for n71..also) this is also a future proof way for more cases and can handle the mandatory/optional aspect also. It may be feasible to extend to other requirements |
| T-Mobile USA | An equation based approach would help with BCS4. |
| Apple | Our contribution R4-2014911 which proposes using equation-based descriptions to simplify the UE RF requirements tables somehow was not included in the contributions list in moderator’s summary. Interested companies please take a look of the examples which we present in our contributions. As a matter of fact, equation-based UE RF requirements table have been used in a few places in the current specifications. |

**Issue 3-2: UL BW limitation**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Maybe we can add a note for the RB position to avoid the large MSD for the large UL BW. The discussion here seems similar with the discussion on the MSD for combination in thread #116 |
| Huawei | One clarification question: it is about channel bandwidth limitation or it is just RB restriction? |
| Qualcomm | Consider asymmetric UL/DL BW combination set 0 and set 1 based on UE capability with set 1 having the 35MHz UL BW. The requirements would still need to be defined for both set 0 and set 1.  RB restriction and position can also be considered, but this also has same effect of restricting BW. |
| Skyworks | Asymmetric Tx/Rx with associated duplex distance allows to do the RB restriction and position clear and since image does not change from existing channel BW compared to the requested larger BW we don’t need any dMPR/AMPR work. This is the advantage versus only RB restriction. This is especially advantageous for n8 and n71 performance. |
| T-Mobile USA | We are fine with UL channel BW limitation. |
| Apple | We agree that 20MHz should be the default operation for n8 and n71. Furthermore, it should be considered to skip UL 35MHz SEM definition for those bands to avoid unnecessary A-MPR characterization process. |
| Huawei | We are ok to UL channel BW limitation and check the detailed proposals. |

**Issue 3-3: new BW handling**

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| --- | --- |
| **Company** | **Comments** |
| ZTE | 1. Does it mean the 35/45M for all bands are optional? We think it should be discussed with the sub-topic 1-1.   2.It seems how to treatt the 35M/45M for the band combination is out of the WID scope. Usually, when a existing band combination supports a new channel bandwidth, new BCS is needed. It depends on the proponents and similar situations are happened for the other bands. RAN4 is discussing the similar issues in thread [#146] |
| Qualcomm | At least optional support for earlier release. |
| Skyworks | We agree that this is related to 1-1 but regardless we are concerned if 35MHz/and 45MHz becomes a generic mandatory BW we will see any band (and subsequent combinations) that supports up to 40 or 50MHz requesting 35MHz or 45MHz without real justification and result in a large work in terms of MSD/MPR/AMPR. This is not just a tick in a box work. For this reason at least within this release we do not believe these BW become available to any band. we have seen many errors/missed requirements because of new BW being treated in a basket approach. |
| T-Mobile USA | We agree that 35 and 45 MHz should be optional for Rel-15 and Rel-16, and would be added only based on operator demand.  The best way to avoid needing new BCSs for the new channel BWs is to agree with the proposal for BCS4 in R4-2016453 (or revision thereof). |
| Nokia | Release independence should be discussed in topic 1-1.  If 35/45MHz is not treated in the basket, how does an operator request these bandwidths? Do you need a WI for each band?  Regarding BCS issues, the general solution should be agreed in [97e][146] BC\_simplification. |
| Apple | The support of new channel BWs should be optional in the current release and whether they would become mandatory in future releases is subject to further discussions. We also support proposal 1 in R4-2016060 to refrain from adding new BCSs containing newly introduced channel BWs at least in the current release of specifications. |

**Issue 3-4: n3 35MHz and 45MHz REFSENS**

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| **Company** | **Comments** |
| ZTE | Agree with UL configuration. The REFSEN values should be averaged among companies. |
| Huawei | Agree with UL configuration |
| Ericsson | Ok to average REFSEN |
| Qualcomm | Not supporting average.  Let’s discuss science.  40MHz REFSENS is already approved for n3 and Murata’s 45MHz value is lower than the approved 40MHz value, which is concerning. Perhaps the PA used by Murata was not an efficiently biased ET type PA which could lower the intermodulation between the CIM3 and TX signal. QC values are more in line with the requirements defined for both 30MHz and 40MHz that have TX distortion landing in RX BW. It is recommended that Skyworks provide measurement data as well. |
| Skyworks | Ok with UL configuration proposal. Need to come back with measurements for MSD proposal. We can’t agree with a REFSENS for 35/45MHz that is not consistent with 30 and 40MHz values |
| Apple | We need to understand the technical background on how to determine the UL configurations for REFSENS which include RB numbers and location where they are placed. For example, not all restricted RBs are located as close as to the DL band. The UL configurations need to be agreed before the REFSENS can be determined. |

**Issue 3-5: n8 35MHz REFSENS**

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| **Company** | **Comments** |
| Qualcomm | * Apple’s analysis is pessimistic because it assumes TX signal would act like an IBB2 blocker which would be 12dB higher than the standard -44dBm, and REFSENS would be derived by the amount signal level to be raised 11.5+12=23.5dB to overcome the scaled IBB2 blocker of -32dBm.   + Problem with approach is that at max power, IM3 of Image and TX, causes de-sense.   + Also, per 36.101, the IBB2 blocker test range needs to be modified for any channel BW at the lower part of RF band.   Murata’s value for n8 should not be much different than the value for n71 |
| Skyworks | MSD:  We present 3 MSD evaluations: worst case 35M UL / 35M DL, worst case 20M UL/35M DL and best case 20M UL/35M DL. Our preference is to restrict UL CBW operation to 20MHz as MSD can be moderate (worst case) to neglectable (best case ). If acceptable, our proposal 1 can be modified to propose 20MHz UL best and worst case REFSENSE.  UL configuration: We show that Tx noise in Rx is nearly constant over LCRB range: 10-60RBs. So all values proposed are acceptable. We propose LCRB=25RB . In any case we believe limitation of UL BW should be seriously considered as it provides best MSD and no rework on UL side, ultimately providing the best case DL throughput and range. |
| Apple | We need to understand the technical background on how to determine the UL configurations for REFSENS which include RB numbers and location where they are placed. For example, not all restricted RBs are located as close as to the DL band. The UL configurations need to be agreed before the REFSENS can be determined. |
| MediaTek | UL configuration determines the REFSENS MSD. To align the used UL configuration is needed first. |
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**Issue 3-6: n25 35MHz and 45 MHz REFSENS**

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| **Company** | **Comments** |
| Qualcomm | Same comments as in n3 |
| Skyworks | UL configuration:  for 35MHz, we do not expect any impact between 40 or 45 LCRB. For 45MHz, we also do not expect major impact on Tx noise level but would need measurements to confirm.  REFSENS: We need to come back with measurement data to confirm proposed values. |
| Apple | We need to understand the technical background on how to determine the UL configurations for REFSENS which include RB numbers and location where they are placed. For example, not all restricted RBs are located as close as to the DL band. The UL configurations need to be agreed before the REFSENS can be determined. |
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**Issue 3-7: n71 35MHz REFSENS**

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| **Company** | **Comments** |
| Qualcomm | Same comments as in n71 |
| Skyworks | Same comment as for n8.  UL configuration: We show that Tx noise in Rx is nearly constant over LCRB range: 10-60RBs. So all values proposed are acceptable. We propose LCRB=25RB .  MSD:  We present 3 MSD evaluations: worst case 35M UL / 35M DL, worst case 20M UL/35M DL and best case 20M UL/35M DL. Our preference is to restrict UL CBW operation to 20MHz as MSD can be moderate (worst case) to neglectable (best case). If acceptable, our proposal 1 can be modified to propose 20MHz UL best and worst case REFSENSE.  We also present A-MPR measurements which show that restricting UL to 20MHz not only improves DL REFSENSE but also enhances uplink performance since no A-MPR is needed. 35MHz Uplink leads to high MSD (22dB) and high A-MPR (12 – 14 dB)  In any case we believe limitation of UL BW should be seriously considered as it provides best MSD and no rework on UL side, ultimately providing the best case DL throughput and range. |
| Apple | We need to understand the technical background on how to determine the UL configurations for REFSENS which include RB numbers and location where they are placed. For example, not all restricted RBs are located as close as to the DL band. The UL configurations need to be agreed before the REFSENS can be determined. |
| MediaTek | UL configuration determines the REFSENS MSD. To align the used UL configuration is needed first. |
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**Issue 3-8: n7 35 MHz A-MPR**

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| **Company** | **Comments** |
| Qualcomm | Common ground between QC and SWKS:     * QCOM thresholds are based on actual RB sweeps for CIM3, 5th order, and IM3 distortion except TBD1, TBD2, and TBD3. * SWKS thresholds are based on interpolation * Potential agreement/compromise/common ground will contain thresholds from actual RB sweeps and choose between TBDX=[SWKS, QCOM]: TBD1 = [15.84, 13.5], TBD2=[3.06, 2.7], and TBD3=[12.6, 9] |
| Skyworks | Both proposals are similar, we are open to discuss threshold with other companies. |
| Apple | Simulations showed that the A4 has to be slightly increased to fully cover the region in need of higher A-MPR. We propose to change the border of A4 to 3.42MHz and consequently match A5. |
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**Issue 3-9: n25 and n66 A-MPR**

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| **Company** | **Comments** |
| ZTE | Agree with the Updated NS\_03 requirement. We have the same proposals in R4-2015044. |
| Ericsson | Agreed |
| Qualcomm | Prefer to use same NS\_03 AMPR for 35MHz and 45MHz as specified in TS38.101-1 with agreed requirement |
| Skyworks | We propose to use equation based approach so that we don’t need to explicitely need to introduce 35 and 45MHz. This approach is already use fo DC and CA and is described in R4-2014911. Note that this is not needed for asymmetric UL/DL with UL limited at 20MHz |
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**Issue 3-10: n71 35 MHz A-MPR**

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| **Company** | **Comments** |
| ZTE | Agree with the SEM requirement for NS\_35. We have the same proposals in R4-2015044. |
| Ericsson | Agree on the SEM requirements, support WF |
| Qualcomm | Agree on recommended WF. |
| Skyworks | Agree on SEM requirements, we provide initial A-MPR measurements that indicate at least 12dB is needed. Further measurements are needed. Same comment than for NS\_03 on using equation based table. Note that this is not needed for asymmetric UL/DL with UL limited at 20MHz |
| Apple | According to our simulations A-MPR of 1.5dB is required for DFT-s-OFDM with -23.5dBm limit in 0-0.1MHz bin. This increases MPR by 0.5dB. Additionally, if coexistence requirements are considered then up to 10dB power backoff is required for QPSK CP-OFDM. The analysis includes a filter rejection assumption of 9dB for the protected regions (e.g. band 29). Therefore, we propose to use asymmetric UL/DL by limiting the UL to 20MHz. With asymmetric UL/DL the 35MHz SEM should not be defined. Otherwise A-MPR would have to be determined for 35MHz CBW. |

## 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: Expanding Specification Tables | Further discussion is needed  Recommendations for 2nd round: further discussion on the equations based approach with the examples described in R4-2014911 and capture the potential agreements made on sub-topic 3-1, 3-2 and 3-3 in the WF2. |
| Issue 3-2: UL BW limitation | Based on 1st round discussion, UL BW limitation can reduce the MSD for DL and also reduce the work for UL A-MPR. And some operator indicate to support the approach.  Recommendations for 2nd round: further discussion on the detailed proposals and capture the potential agreements made on sub-topic 3-1, 3-2 and 3-3 in the WF2. |
| Issue 3-3: new BW handling | Further discussion is needed  Recommendations for 2nd round: further discussion on new BW handling and capture the potential agreements made on sub-topic 3-1, 3-2 and 3-3 in the WF2. |
| Issue 3-4: n3 35MHz and 45MHz REFSENS | * Tentative agreements   + For n3 35MHz and 45MHz UL configuration, 50RB is used for 15 KHz SCS, 24RB is used for 30 KHz SCS, and10RB is used for 60 KHz SCS   Recommendations for 2nd round: agree on the tentative agreements above and capture it in WF3. The MSD will come back next meeting. |
| Issue 3-5: n8 35MHz REFSENS | Recommendations for 2nd round: further discussion on UL configuration and capture it in WF3. The MSD will come back next meeting. |
| Issue 3-6: n25 35MHz and 45 MHz REFSENS | Recommendations for 2nd round: check whether we can agree on UL configuration and capture it in WF3. The MSD will come back next meeting. |
| Issue 3-7: n71 35MHz REFSENS | Recommendations for 2nd round: further discussion on UL configuration and capture it in WF3. The MSD will come back next meeting. |
| Issue 3-8: n7 35 MHz A-MPR | Recommendations for 2nd round: The A-MPR value for NS\_46 can be reused and further check if companies can get agreement on A-MPR regions and capture the agreements in WF3. |
| Issue 3-9: n25 and n66 A-MPR | * Tentative agreements   + 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   Recommendations for 2nd round: agree on the tentative agreements above and take equation based approach into account which is discussed in 3-1, and capture the agreements in WF3. |
| Issue 3-10: n71 35 MHz A-MPR | It is related to the discussion on issue 3-2 UL BW limitation  Recommendations for 2nd round: further discussion on SEM requirement for NS\_35 and capture the agreements 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 general aspects for UE RF requirements | Skyworks |
| WF3 | WF on UE REFSENS and A-MPR for 35MHz and 45MHz CBW | Qualcomm |

## Discussion on 2nd round (if applicable)

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| **WF number** | **Comments collection** |
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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*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
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# Topic #4: UE draft CRs

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2015044 | ZTE Corporation | On UE RF requirement for new channel bandwidth of 35MHz and 45MHz |
| R4-2015702 | Huawei, HiSilicon | Draft CR for TS 38.101: introduction of channel bandwidths 35MHz and 45MHz for general part |
| R4-2016059 | Ericsson | Draft CR to add 35MHz and 45 MHz Bandwidth to TS38.101-1 |
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## Companies views’ collection for 1st round

### CRs/TPs comments collection

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| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2015044 | Huawei: we suggest to focus on general part for this meeting since for the discussion on band specific requirement is ongoing. |
| Ericsson: Almost complete CR (with FFS in some places), still missing CA, SUL, etc combos that are still open for discussion. |
| Skyworks: we agreed with the values but too early to agree on CRs especially depending on whether these channel BW are mandatory/optional/generic to all bands… |
| Apple: We suggest to have a merged draft running CR to capture all the necessary changes in the specifications. However, since Rel-17 specifications is not available yet, we are not sure how to track the endorsed CR contents and how to contribute to the changes in future meetings. Is there going to be a draft Rel-17 specifications?  We also encourage companies to consider the UE RF requirements table simplification as proposed in R4-2014911 as we have seen some requirements table exceeding the document page width after adding the new channel BWs. |
| R4-2015702 | ZTE: We think we capture all the possible changes in our contribution R4-2015044 by introducing 35/45M in the spec, not only for the ‘general part’ but also for the other parts although they are FFS for now. |
| Ericsson: Some editorial comments:  In Table 7.4-1: no changes seen.  In Table 7.5-1 & Table 7.5-3: & Table 7.6.2-1: & Table 7.7-1: new BWs not in right place in the tables. |
| Skyworks: we agreed with the values but too early to agree on CRs especially depending on whether these channel BW are mandatory/optional/generic to all bands… |
| Apple: Same comments for R4-2015044 |
| R4-2016059 | ZTE: Incomplete clauses. We think we capture all the possible changes in our contribution R4-2015044 by introducing 35/45M in the spec, not only for the ‘general part’ but also for the other parts although they are FFS for now. |
| Ericsson: Agree with above comment, R4-2015044 more complete but CA, SUL etc combos missing  Suggestion: Combine these three papers to a common joint CR for next meeting that can be circulated in advance. |
| Skyworks: we agreed with the values but too early to agree on CRs especially depending on whether these channel BW are mandatory/optional/generic to all bands… |
| Apple: Same comments for R4-2015044. It is also interesting to see the table orientation change (from horizontal to vertical) in this draft CR for maximum transmission bandwidth configuration and minimum guardband to allow more space for adding new channel BWs. This is also in line with our view that some requirements table simplification or restructuring may be needed to improve the specifications editability and readability. |
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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** |
| Overall | Based on 1st round comments, companies comment that it is too early to agree on the CR pending some general issues. It is also suggested to combine the three papers to a running draft CR which moderator think it is doable. |
| R4-2015044 | *To be revised* |
| R4-2015702 | *To be noted* |
| R4-2016059 | *To be noted* |

## Discussion on 2nd round (if applicable)

# Topic #4: BS draft CRs

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2015703 | Huawei, HiSilicon | draft CR on introduction of channel bandwidths 35MHz and 45MHz for BS TX |
| R4-2015718 | Ericsson | Draft CR to TS 38.104: Introduction of CBWs 35 MHz and 45 MHz |
| R4-2015719 | Ericsson | Draft CR to TS 38.141-1: Introduction of CBWs 35 MHz and 45 MHz |
| R4-2015720 | Ericsson | Draft CR to TS 38.141-2: Introduction of CBWs 35 MHz and 45 MHz |
| R4-2016114 | ZTE Corporation | Discussion on BS RF requirement for new channel bandwidth of 35MHz and 45MHz |
| R4-2016115 | ZTE Corporation | Draft CR to TS 38.104: Introduction of 35MHz and 45MHz |
| R4-2016116 | ZTE Corporation | Draft CR to TS 38.141-1: Introduction of 35MHz and 45MHz |
| R4-2016117 | ZTE Corporation | Draft CR to TS 38.141-2: Introduction of 35MHz and 45MHz |
| R4-2016118 | ZTE Corporation | Draft CR to TS 37.104: Introduction of 35MHz and 45MHz |
| R4-2016119 | ZTE Corporation | Draft CR to 37.141: Introduction of 35MHz and 45MHz |
| R4-2016120 | ZTE Corporation | Draft CR to TS 37.105: Introduction of 35MHz and 45MHz |
| R4-2016121 | ZTE Corporation | Draft CR to 37.145-1: Introduction of 35MHz and 45MHz |
| R4-2016122 | ZTE Corporation | Draft CR to 37.145-2: Introduction of 35MHz and 45MHz |

## Companies views’ collection for 1st round

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| R4-2015703 | ZTE: spec version should be 17.0.0 instead of 16.5.0. In addition, in Table 6.6.3.2-3 Note 4, 35MHz/45MHz is missing. |
| Huawei: agree with the comments above |
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| R4-2015718 | ZTE:spec version should be 17.0.0 instead of 16.5.0.  Table 6.6.3.2-2a and 6.6.3.2-3, 35MHz/45MHz is missing in Note 4.  For dynamic range requirement, interfering signal power level is missing.  For RX intermodulation, freq offse for NBB and general intermodulation is not aligned with ours, more discussion are needed.  EVM window length is not added. |
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| R4-2015719 | ZTE:spec version should be 17.0.0 instead of 16.5.0.  For RX intermodulation, freq offse for NBB and general intermodulation is not aligned with ours, more discussion are needed. |
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| R4-2015720 | ZTE: Table 6.7.3.5.1-2a and Table 6.7.3.5.1-3, 35MHz/45MHz is missing in the Note.  For dynamic range requirement, interfering signal power level is missing for 45MHz..  For RX intermodulation, freq offse for NBB and general intermodulation is not aligned with ours, more discussion are needed. |
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| R4-2016115 | Ericsson: missing clause 5 for transmission bandwidth configuration, guard band definition. Also a few differences in values calculated between Ericsson submitted CR on BS RF.  As a suggestion, we would propose to perhaps pull out the requirements where there is a difference to assist in further discussion. |
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| R4-2016116 | Ericsson; Missing clause 6.5 EVM Test requirement  As a suggestion, we would propose to perhaps pull out the requirements where there is a difference to assist in further discussion. |
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| R4-2016117 | Ericsson: Missing updates to Table 6.6.3.5.1-2, 6.6.3.5.1-3, 6.6.3.5.1-4 including 35/45 MHz EVM window length for *BS type 1-O*.  As a suggestion, we would propose to perhaps pull out the requirements where there is a difference to assist in further discussion. |
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| R4-2016118 |  |
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| R4-2016119 |  |
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| R4-2016120 |  |
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| R4-2016121 |  |
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| R4-2016122 |  |
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| General comment to this topic #4 | Nokia: It is recommended to focus discussion on CR to 38.104 this meeting and agree on the work split for next meeting |

## 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** |
| General | Nokia recommended to focus the discussion on CR to 38.104 this meeting. Moderator found that companies have already contribute and made comment on 38.104 and 38.141. Meanwhile no comments are received for 37 serials. Hence Moderator suggest to continue discussion on 38.104 and 38.141, and agree on the work split on the remaining BS specs. |
| R4-2015703 | *To be revised* |
| R4-2015718 | *To be noted* |
| R4-2015719 | *To be revised* |
| R4-2015720 | *To be noted* |
| R4-2016114 | *To be noted* |
| R4-2016115 | *To be noted* |
| R4-2016116 | *To be noted* |
| R4-2016117 | *To be revised* |
| R4-2016118 | *To be noted* |
| R4-2016119 | *To be noted* |
| R4-2016120 | *To be noted* |
| R4-2016121 | *To be noted* |
| R4-2016122 | *To be noted* |

## Discussion on 2nd round (if applicable)