**3GPP TSG-RAN WG4 Meeting #94-e R4-20xxxxx**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item:** 9.14

**Source:** Moderator (Sprint)

**Title:** Email discussion summary for RAN4#94e\_#27\_LTE\_NR\_B41\_Bn41\_PC29dBm

**Document for:** Information

# Introduction

This e-mail discussion will cover contributions for the LTE\_NR\_B41\_Bn41\_PC29dBm Work Item, submitted under Agenda Item 9.14.

To submit comments delegates are asked to enter comments in the appropriate tables below in this word doc, rename the file by adding your company name at the end (before .docx). To limit the number of e-mail attachments, delegates are requested to upload the file to the draft inbox in this e-mail discussion input for 29 dBm HPUE:

<ftp://ftp.3gpp.org/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%2327_LTE_NR_B41_Bn41_PC29dBm/e-mail_discussion_input/>

or

<https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%2327_LTE_NR_B41_Bn41_PC29dBm/e-mail_discussion_input>

Note: To upload files you must use your 3GPP userid and password to login. If you are not able to login, then you can send the file to the reflector with the proper subject for this discussion: RAN4#94e\_#27\_LTE\_NR\_B41\_Bn41\_PC29dBm

Also, if you are able to upload your comment file, in order to let everyone know that there are new comments please send an e-mail to the reflector with the subject RAN4#94e\_#27\_LTE\_NR\_B41\_Bn41\_PC29dBm to announce that your file has been uploaded.

The documents in agenda item 9.14 contain the following four main topics and sub-topics:

* Topic #1: B41/n41 Intra-band EN-DC A-MPR / MPR Improvements
  + Issue 1-1: Can PC2 A-MPR be re-used for PC 1.5?
  + Issue 1-2: A-MPR improvements
  + Issue 1-3: Basic scenario/condition for gNB measurement accuracy requirements
* Topic #2 Issues specific to 29 dBm HPUE
  + Issue 2-1: PC 1.5 behavior when P-Max is not present
  + Issue 2-2: Transmit diversity
  + Issue 2-3: 29 dBm HPUE Power Class Logic
  + Issue 2-4: EVM Impact of Reverse IMD3 on UL MIMO Modulation Order Capability
  + Issue 2-4: Draft CRs

*List of candidate target of email discussion for 1st round and 2nd round*

* 1st round: Tuesday Feb 25, 2020 11:59 pm UTC
* 2nd round: Thursday Feb 27, 2020 11:59 pm UTC

# Topic #1: B41/n41 Intra-band EN-DC A-MPR / MPR Improvements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2000007**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000007.zip) | Apple | **A-MPR Proposal for B41/n41 EN-DC**  Proposal 1: Proposal:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **-13dBm/MHz** | | | | | | **MA =** | **11 :** | **0** | **< B <** | **0.54** | |  | **10 :** | **0.54** | **< B <** | **1.08** | |  | **8 :** | **1.08** | **< B <** | **2.16** | |  | **6 :** | **2.16** | **< B <** | **11.88** | |  | **6 :** | **11.88** | **< B <** | **25.2** | |  | **6 :** | **25.2** | **< B <** | **-** |  |  |  |  |  |  | | --- | --- | --- | --- | --- | | **-25dBm/MHz** | | | | | | **MA =** | **15 :** | **0** | **< B <** | **1.08** | |  | **14 :** | **1.08** | **< B <** | **2.16** | |  | **12 :** | **2.16** | **< B <** | **11.88** | |  | **10 :** | **11.88** | **< B <** | **25.2** | |  | **6 :** | **25.2** | **< B <** | **-** |  |  |  |  |  |  | | --- | --- | --- | --- | --- | | **-30dBm/MHz** | | | | | | **MA =** | **18 :** | **0** | **< B <** | **1.08** | |  | **17 :** | **1.08** | **< B <** | **2.16** | |  | **14 :** | **2.16** | **< B <** | **11.88** | |  | **12.5 :** | **11.88** | **< B <** | **25.2** | |  | **6 :** | **25.2** | **< B <** | **-** | |
| [**R4-2001239**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001239.zip) | LGE | **New A-MPR curves for 29dBm HPUE B41/n41 EN-DC**  **Observation 1:** The current Rel-15 A-MPR curves of -13 dBm/MHz SEM and -25 dBm/MHz SE cannot satisfy the requirements when NS\_04 signaling is indicated for 29 dBm HPUE B41/n41 EN-DC in Rel-16.  **Proposal 1:** It is proposed to take below figure 4, figure 5, and figure 6 as new A-MPR curves for 29 dBm HPUE EN-DC in Rel-16.  **Figure 4. New A-MPR for NS\_04 additional SEM to meet -13 dBm/MHz**  A-MPRIM3 for NS\_04 additional SEM to meet -13 dBm/MHz = MA where MA is defined as follows:  MA =  12 dB; 0≤B<0.54  10 dB; 0.54≤B<1.08  8 dB; 1.08≤B<5.4  6 dB; 5.4≤B<8.1  5 dB; 8.1≤B<13.5  4 dB; 13.5≤B  **Figure 5. A-MPR for NS\_04 SE to meet -25 dBm/MHz for 29 dBm HPUE**  A-MPRIM3 for NS\_04 SE to meet -25 dBm/MHz for 29 dBm HPUE = MA where MA is defined as follows:  MA =  15 dB; 0≤B<1.08  14 dB; 1.08≤B<5.4  13 dB; 5.4≤B<8.1  12 dB; 8.1≤B<10.8  11 dB; 10.8≤B<13.5  10 dB; 13.5≤B<21.6  9 dB; 21.6≤B  **Figure 6. A-MPR for general SE to meet -30 dBm/MHz for 29 dBm HPUE**  A-MPRIM3 for general SE to meet -30 dBm/MHz for 29dBm HPUE = MA where MA is defined as follows:  MA =  18 dB; 0≤B<1.08  17 dB; 1.08≤B<2.16  16 dB; 2.16≤B<2.7  15 dB; 2.7≤B<5.4  14 dB; 5.4≤B<10.8  13 dB; 10.8≤B  **Proposal 2:** any new defined A-MPR curves in this Work item should be only applied to 29 dBm HPUE that supports dual PAs and it shouldn’t be applied to general cases. |
| [**R4-2000423**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000423.zip) | Sprint | **CR for 38.101-3: Allocation aware MPR for intra-band EN-DC**  **CR to make intra-band EN-DC MPR allocation aware, as was done already for A-MPR.** |
| R4-2000425 | Sprint | **Applying the PC2 A-MPR requirements to PC1.5**  Tdoc is late. Pre-meeting e-mail discussions made it apparent that this issue needs to be addressed. A draft will be provided in the folder for this e-mail discussion: <ftp://ftp.3gpp.org/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%2327_LTE_NR_B41_Bn41_PC29dBm/>  <https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%2327_LTE_NR_B41_Bn41_PC29dBm> |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

Intra-band EN-DC A-MPR improvements are in the scope of the WI, but so far agreement cannot be reached on acceptable A-MPR improvements. Also, there is an issue if PC2 EN-DC A-MPR can be re-used for PC1.5 EN-DC.

Allocation aware MPR was proposed at RAN#93 in but there were comments that the power classes should be removed from the section headings.

### Sub-topic 1-1 Can PC2 A-MPR be re-used for PC 1.5?

This sub-topic is for discussion of whether PC1.5 EN-DC can use the same A-MPR as PC2 EN-DC, or if different A-MPR needs to be defined for PC 1.5 EN-DC.

Under the guidance of the RAN4 UE RF chairman the 29 dBm HPUE Work Item has been focused on improving A-MPR for B41/n41 intra-band EN-DC. Some delegates believed the same A-MPR would apply both the PC2 EN-DC UEs as well as 29 dBm 1.5 UEs, while others apparently think the A-MPR needs to be different. This has not been formally agreed at this point but needs to be discussed and agreed before the requirements for 29 dBm HPUE can be finalized.

**Issue 1-1: Is Can PC2 A-MPR be re-used for PC 1.5?**

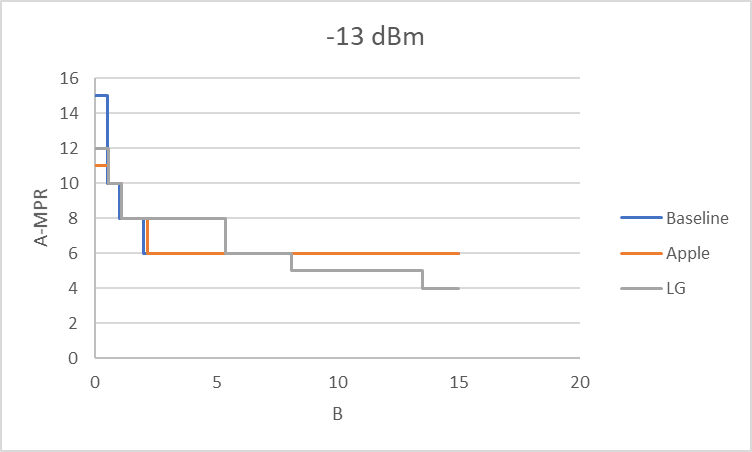
* Proposals
  + Option 1: Agree that PC2 EN-DC A-MPR also applies to PC 1.5 EN-DC
  + Option 2: Agree that separate A-MPR is needed for PC 1.5 EN-DC
  + Option 3: Approve a Way Forward
* Recommended WF
  + Agree that PC2 EN-DC A-MPR can be reused for PC 1.5 EN-DC

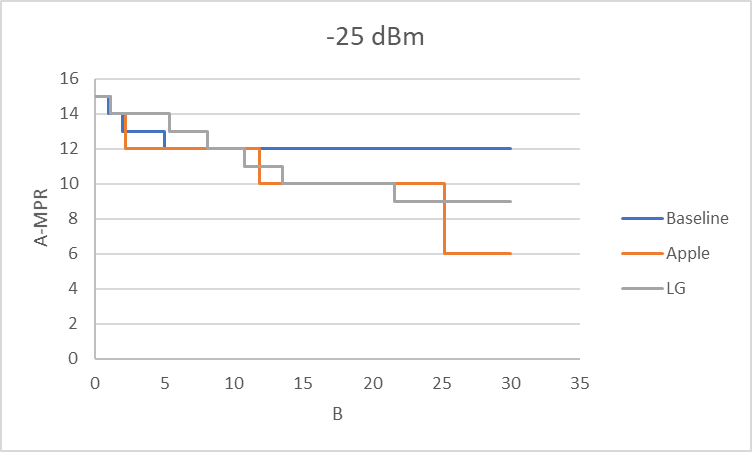
### 1-2: A-MPR improvements

A-MPR improvements have been discussed for several meetings, and there are two proposals at this meeting related to B41/n41 intra-band EN-DC.

**Issue 1-2: A-MPR improvements**

* Proposals





* + Option 1: Apple: A-MPR Proposal for B41/n41 EN-DC
  + Option 2: LGE: New A-MPR curves for 29dBm HPUE B41/n41 EN-DC
  + Option 3: Keep the A-MPR curves as they are.
  + Option 4: Merge proposals. Previous proposals from Skyworks, Intel and Sprint can be considered.
* Recommended WF
  + Attempt to agree on a proposal or merge proposals

### Sub-topic 1-3: Allocation aware MPR

Sprint has proposed allocation Aware A-MPR in [**R4-2000423**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000423.zip)**.** This would bring MPR in line with the allocation-aware A-MPR improvement that has already been incorporated in 38.101-3.

A Draft CR was presented in Reno for allocation Aware A-MPR [R4-1915418](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_93/Docs/R4-1915418.zip). The only feedback was a question about why 26 dBm was in the section title. This has been corrected. This CR is in scope of the WI but otherwise independent of the 29 dBm HPUE work, so the CR could be agreed independent of the rest of the CRs for the WI, just as the CR for allocation aware A-MPR was already approved.

**Issue 1-3: Allocation aware MPR CR**

* Proposals
  + Option 1: Agree the CR in [**R4-2000423**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000423.zip)
  + Option 2: Note the CR.
* Recommended WF
  + Agree the CR in [**R4-2000423**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000423.zip)

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  Sub topic 1-3:  ….  Others: |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2000423**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000423.zip) | Company A |
| Company B |
|  |
|  |  |
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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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### 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** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## 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*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: Issues specific to 29 dBm HPUE

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2000111**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000111.zip) | Qualcomm | Discussion on TX diversity enabling 29 dBm power class  Observation 1: In RAN4 language antenna port is the logical antenna port that is used for configuring UE with e.g. codebook based transmissions and antenna connector is the physical antenna connector from which the signal in an UE comes out.  Observation 2: Current UL MIMO specification can not be re-used for TX diversity since the different assumptions for PA power capability  Observation 4: 29 dBm with two 26 dBm application likely provides benefits in low uplink signal BW applications.  Proposal: Enable TX diversity for 29 dB power class in RAN4 specifications by defining reference plane for all powers including emissions as summed from all TX antenna ports. |
| [**R4-2000112**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000112.zip) | Qualcomm | Draft CR to enable tx diversity for 29 dBm power class |
| **[R4-2000424](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000424.zip)** | Sprint | New SIB parameter to allow 29 dBm operation for LTE  Observation 1: For NR there is agreement that a 29 dBm capable UE can transmit at 29 dBm unless a lower P-Max is broadcast in the SIB. (Moderator note: Should have said “For NR and EN-DC”)  Proposal 1: Introduce a new parameter P-MaxR that would be used to enable the network to allow LTE UE transmit power of greater than 26 dBm while not impacting the calculation of Pcompensation for legacy LTE UEs.  Proposal 2: RAN4 should ask RAN 2 if P-MaxR could be introduced into the RAN2 specs in a backwards compatible manner back to Release 13. |
| [**R4-2000426**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000426.zip) | Sprint | 29 dBm HPUE Power Class logic  Proposal 1: Agree to the proposed text v2 for PC 1.5 power control in 38.101-1. (Moderator note: tdoc said 38.101-3, but should have been 38.101-1)  Proposal 2: Agree to the proposed text for PC 1.5 intra-band EN-DC in 38.101-3. |
| [**R4-2000905**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000905.zip) | CMCC | Proposal on 29dBm P-Max issue for NR and LTE  Proposal 1:For 5G NR 29dBm UE, the requirements for 29dBm should apply If p-MAX is absent.  Proposal 2: For LTE 29dBm UE if P-max is absent，the corresponding requirements for 29dBm UE shall apply, and operator can set the p-max as 23dBm/26dBm to avoid the use of HPUE in some countries with HPUE regulatory limitation. |
| [**R4-2001547**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001547.zip) | Skyworks | [29dBm] EVM Impact of Reverse IMD3 on UL MIMO Modulation Order Capability  Observation on EVM:  • For QPSK to 64QAM the RIMD3 budget is >3% (~30 dB) which is reasonable  • For 256QAM the RIMD budget is slightly more than 1% (40 dB)  Observations for full 29 dBm power:  • At the agreed antenna isolation assumption of 10 dB:  o CP-OFDM can only support QPSK  o DFT-s-OFDM can only support 16QAM  o Note that in most case there is MPR for CP-OFDM and higher order modulations so RIMD3 level will reduce for those cases  o It seems reasonable that with the allowed MPR would enable up to 64QAM transmissions but 256QAM with >5 dB MPR would need to be verified  • Note that the gain on IMD3 power is small when isolation is increased by 1 dB  • At >13 dB isolation and accounting for the allowed MPR up to 256QAM should be feasible  Observations for two PC2 linear PAs and 10dB antenna isolation:  • QPSK is feasible at full power  • 16QAM is feasible starting from 1 dB MPR  • 64QAM is feasible starting from 2 dB MPR  • 256QAM is feasible starting from 6 dB MPR  • Note that this is a best case compared to PAs using ET or APT but provides a first feel for where problems may occur.  Observation: Based on linear PA measurements only and needing further study for ET and APT PAs:  • No additional MPR may be needed for PC2 implemented with two PC2 PAs  • Depending on waveform and allocation types, some small additional MPR may be needed for PC1.5  • For PC2 implemented with two PC3 PAs, depending on waveform and allocation types some small additional MPR may be needed  • For PC3 implemented with two PC3 PAs, no additional MPR may be needed |
| [**R4-2002138**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002138.zip) | Sprint | Draft CR for 38.101-1: Introduction of Power Class 1.5 |
| [**R4-2002140**](file:///C:\Users\ne087952\OneDrive%20-%20Sprint\3GPP\RAN4\TSGR4_94_eMeeting\Docs\R4-2002140.zip) | Sprint | Draft CR for 38.101-3: Introduction of Power Class 1.5 |
|  |  |  |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

An agreement is needed on the UE power class requirements are for a PC 1.5 capable UE when P-Max is not signalled. Also, there is not yet agreement on the requirements for PC 1.5 transmit diversity. The HPUE Power Class logic has not yet been discussed but needs to be agreed. A new issue of the impact of reverse IMD3 impact on UL modulation order capability.

### Sub-topic 2-1: PC 1.5 behavior when P-Max is not present

Currently there is agreement that PC 1.5 will be allowed P-Max is not present for NR and EN-DC. There is currently a standoff between some operators related to PC1.5 (29 dBm) operation for LTE when P-Max is absent. CMCC would like UEs to be able to operate at 29 dBm when P-Max is not present. They are concerned of the impact on cell selection if P-Max is sent. They would prefer operators set P-Max to 23 or 26 dBm where 29 dBm operation is not allowed. KDDI and Softbank say that 29 dBm operation is currently not legal in Japan, and it is not reasonable to have them reconfigure tens of thousands of LTE eNBs to transmit P-Max.

**Issue 2-1: Power Class 1.5 behaviour when P-Max is not present**

* Proposals
  + Option 1: Add a new SIB parameter to allow 29 dBm operation in LTE as proposed in R4-2000424.
  + Option 2: Allow 29 dBm operation when P-Max is not present as proposed in R4-2000905.
  + Option 3: Only allow 29 dBm operation in NR and EN-DC for now, and not in LTE so that the Work Item can be completed. If an arrangement can be found in the future, then PC 1.5 may be enabled for LTE at that time.
* Recommended WF
  + Option 3: Only allow 29 dBm operation in NR and EN-DC for now, and not in LTE so that the Work Item can be completed. If an arrangement can be found in the future, then PC 1.5 may be enabled for LTE at that time.

### Sub-topic 2-2: Transmit diversity

Transparent Tx Diversity for PC1.5 operation was added to the scope of the WID in December.

**Issue 2-2: Transmit Diversity**

* Proposals
  + Option 1: Enable TX diversity for 29 dB power class in RAN4 specifications by defining reference plane for all powers including emissions as summed from all TX antenna ports as described in R4-2000111 and R4-2000112.
  + Option 2: ?
* Recommended WF
  + Agree to Option 1

### Sub-topic 2-3: 29 dBm HPUE Power Class Logic

The logic for which power4 class applies in different scenarios including if P-Max is present, the value of P-Max, the UE capability and the NR duty cycle and the LTE UL/DL configuration (for EN-DC).

**Issue 2-3: 29 dBm HPUE power class logic**

* Proposals
  + Option 1: Approve the logic proposed in R4-2000426 for NR and EN-DC.
  + Option 2: Approve the logic proposed in R4-2000426 with modifications
* Recommended WF
  + Agree to Option 1.

### Sub-topic 2-4: EVM Impact of Reverse IMD3 on UL MIMO Modulation Order Capability

There is a discussion document on [29dBm] EVM Impact of Reverse IMD3 on UL MIMO Modulation Order Capability in R4-2001547.

**Issue 2-4: EVM Impact of Reverse IMD3 on UL MIMO Modulation Order Capability**

* Proposals
  + Option 1: Review the document and see if there are any comments. Companies are encouraged to consider the issue of RIMD3 related EVM.
* Recommended WF
  + Please review the document and consider looking into this issue. Comments welcome.

### Sub-topic 2-5 Draft CRs

Two Draft CRs for PC1.5 have been submitted in R4-2002138 and R4-2002140. These are not for endorsement, only for discussion and feedback.

**Issue 2-5: Documents for discussion**

* Proposals
  + Option 1: Review the draft CRs and provide feedback.
* Recommended WF
  + Please review the documents and comments are welcome.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 2-1:  Sub topic 2-2:  Sub topic 2-3:  Sub topic 2-4:  Sub topic 2-5:  ….  Others: |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## 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*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |