**3GPP TSG-RAN WG4 Meeting # 98-bis-e R4-210XXXX**

**Electronic Meeting, 12th – 20th April, 2021**

**Agenda item:** 7.37

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for [98-bis-e][123]HPUE\_PC1\_5\_n77\_n78

**Document for:** Information

# Introduction

This document summarizes the email discussion on topics related to Power Class 1.5 in Bands n77 and n78 in Agenda 7.37. Additionally, discusison on PC 1.5 in Band n79 in Agenda 7.40 is treated in this thread. The discussion is divided into two topics:

Topic #1: UE RF assumptions and requirements

Topic #2: RF exposure regulatory aspects for FWA

# Topic #1: UE RF assumptions and requirements

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2104893**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104893.zip) | Apple | Considerations for PC1.5 with band n79  **Observation 1:** PC1.5 is achieved via dual Tx chains as there is no 29dBm power amplifier deployed in UEs and requires higher power backoff compared to single Tx operation.  **Observation 2:** PC1.5 MPR was developed for single and dual layer UL-MIMO operation but not for TxD.  **Proposal 1:** PC1.5 TxD in band n79 for should only be enabled when the general discussion on TxD is finished in RAN4.  **Proposal 2:** If improvements for power backoff are considered for n79 then the relevant measurement assumptions (Antenna isolations of 10 dB, 4 dB post PA loss and 26dBm Tx chains) shall be reused to obtain reliable results. |
| [**R4-2104957**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104957.zip) | vivo | Discussion on PC1.5 with n79  **Proposal 1: The measurement and simulation assumption of n41 for MPR and A-MPR [3] is proposed to be baseline of n79.**  **Proposal 2: Reuse n41 PC1.5 duty cycle-based SAR mechanism.**  **Proposal 3: Release independent for PC 1.5 with 79 is proposed.** |
| [**R4-2104975**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104975.zip) | LGE | MPR for PC 1.5 NR UE on n77/n78 or n79  **Proposals 1 and 2 relate to smartphone UE**  Proposal 1: RAN4 should consider above basic simulations assumptions in for MPR requirements for PC 1.5 UE at n77/n78 or n79 in Rel-17.  Proposal 2: If Proposal 1 is reasonable to derive n77/n78 or n79 MPR requirements for smart phone type UE, then RAN4 can reuse MPR requirement in Table 6.2.2-4 for PC1.5 UE with dual Tx in TS38.101-1.  **Proposal 3, 4, and 5 relate to FWA UE**  Proposal 3: RAN4 can consider default duty cycle ratio with [25~50%] since there was no impact to human body directly for PC1.5 FWA device using same IE.  *Moderator: This aspect can be discussed under topic 2.*  Proposal 4: RAN4 can derive MPR requirements based on the above simulations assumptions for PC1.5 FWA UE in n77/n78.  Proposal 5: The following proposal 3 & 4 can be applied for PC1.5 n79 FWA UE. |
| [**R4-2105012**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105012.zip) | CMCC | Discussion on the PC1.5 UE RF requirements of NR n79  **Proposal 1: The MOP and Tolerance are to be specified as 29dBm +2/-3 dB for band n79 of power class 1.5.**  **Proposal 2: Considering that n79 29dBm (power class 1.5) is a dual PA architecture, the value of ∆TRxSRS can reuse the value of ∆TRxSRS PC2.**  **Proposal 3: The MOP and Tolerance for UL MIMO are to be specified as 29dBm +2/-3 dB for n79 of power class 1.5.**  **Proposal 4: No changes to Maximum power reduction (MPR) for power class 1.5 with dual Tx (Table 6.2.2-4)**  **Proposal 5: Since no A-MPR issue for PC1.5 n97, No changes to section 6.2.3 are needed.**  **Proposal 6: The n79 power class 1.5 can be supported form Rel-15 by release independent manner.** |
| [**R4-2107317**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107317.zip) | Skyworks | Discussion on PC1.5 performance for FWA  **Observation: current PC1.5 MPR in 38.101-1 should apply to band n79 smartphone UEs as same antenna isolation can be assumed and there is no band specific regulation justifying an A-MPR.**  **Observation: based on previous reverse IMD measurements, the antenna isolation requires significant improvement to result in noticeable MPR gains.**  **Observation: In order to improve the MPR for an PC1.5 FWA implementation it is not sufficient to significantly improve the antenna isolation, the isolation between paths at PCB level should also improve significantly.** |
| [**R4-2107352**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107352.zip) | Qualcomm | PC 1.5 for FWA devices  **Proposal: Based on the feedback from FWA vendors, it is proposed to assume antenna isolation of 20 dB for FWA.**  **Proposal: PCB isolation effect can be neglected.**  **Proposal: Post-PA front-end loss assumed to be 4 dB per Tx chain.**  Baseline MPR proposal for FWA  Inner: No additional MPR compared to PC2  Outer: No additional MPR compared to PC2 for DFT-S-OFDM. Additional [2] dB for CP-OFDM except for 256QAM which is dominated by EVM.  Edge: Needs further study |
| [**R4-2107353**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107353.zip) | Qualcomm | PC 1.5 in Band n79  **Observation: With the significant MPR defined for PC1.5, it is not expected that the coverage enhancement expectations expressed in the WID can be met.**  **Proposal: PC 1.5 MPR needs to be further studied in the context of Band n79.**  **Observation: Most of the provided measurements and proposals for PC 1.5 indicate a smaller MPR than was eventually specified. There appears to be scant technical justification for the specified values.**  **Proposal: There is no current additional spurious emission requirement for Band n79. However, increasing the power level to 29 dBm may motivate the need to revisit UE coexistence protection to other bands and coexistence to other services such as radio altimeters.** |

## Open issues summary

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

### Sub-topic 1-1

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

Can the MPR defined for PC1.5 in Band n41 be used for smartphone for n77, n78, and n79?

The MPR was derived based on UE capability, but is it acceptable from network deployment perspective if a UE only meets the minimum requirement?

The specified MPR for PC1.5 from Band n41 does not appear well aligned with provided measurements and proposals. How is it justified?

The MPR was derived from Band n41 component performance, but Band n79 is almost an octave in frequency higher. Does the difference in frequency impact the assumptions and therefore the MPR?

Can the MPR apply to UL MIMO (single and dual layer) as well as TxDiv?

**Issue 1-1: Smartphone MPR**

* Proposals
  + Option 1: Existing PC 1.5 MPR applies to Band n77, n78, and n79
  + Option 2: Existing PC 1.5 MPR applies to Band n77, n78, but further study needed to determine whether it can apply for Band n79
  + Option 3: Further study is needed to determine whether existing PC 1.5 MPR can be applied to Band n77, n78, and n79 or whether modifications are needed
* Recommended WF
  + TBA

### Sub-topic 1-2

For FWA, it is understood that the same assumptions as smartphone will not apply, for example, antenna isolation. However, how much impact will this make to the MPR? If it is only a small impact to MPR, then it isn’t justified to define a separate requirement for it. What assumptions should be used in evaluating FWA MPR?

**Issue 1-2: FWA MPR**

* Proposals
  + Option 1: Reuse smartphone MPR for FWA, no further study is needed.
  + Option 2: Evaluate FWA MPR to quantify the amount of improvement. Assumptions are antenna isolation = 20 dB, PCB isolation >75 dB, post PA loss = 4 dB
* Recommended WF
  + TBA

### Sub-topic 1-3

Other Band n79 UE requirements include maximum output power and tolerance, DT\_RxSRS, MOP and tolerance for UL MIMO, and A-MPR.

**Issue 1-3: UE RF requirements for Band n79**

* Proposal 1: MOP and tolerance is 29 dBm +2/-3 (agree or if not, what is your alternate proposal)
* Proposal 2: DT\_RxSRS is the same as PC2 (agree or if not, what is your alternate proposal)
* Proposal 3: MOP and tolerance for UL MIMO is 29 dBm +2/-3 (agree or if not, what is your alternate proposal)
* Proposal 4
  + Option 1: No A-MPR for Band n79
  + Option 2: Study whether A-MPR is needed for Band n79 for coexistence due to the higher Tx power
* Recommended WF
  + TBA

### Sub-topic 1-4

For smartphone SAR, can the same method identified for Band n41 also be used for Band n77, n78, and n79? If FWA uses a different method, how should this be indicated to the network? If a different method is used between smartphone and FWA, does the network need to know whether the device is smartphone or FWA?

**Issue 1-4: Smartphone SAR**

* Proposal 1: For smartphone, the same method as identified for Band n41 is also used for Band n77, n78, and n79. (agree or do not agree?)
* Proposal 2: If a different method is used between smartphone and FWA, then an indication is needed to inform the network (agree, disagree, or defer until after we decide how to manage RF exposure for smartphone and FWA)
* Recommended WF
  + TBA

### Sub-topic 1-5

Release independence to R15 for Band n77, n78, and n79

**Issue 1-5: Release independence**

* Proposal
  + Option 1: PC 1.5 for n77, n78, and n79 are release independent to R15
  + Option 2: Wait for specifications to be finished before making a determination on release independence due to possible need for signaling (SAR, FWA MPR, etc).
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

Sub topic 1-1: Smartphone MPR

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| **Company** | **Comments** |
| Skyworks | **Issue 1-1:** Option 1: Existing PC 1.5 MPR applies to Band n77, n78, and n79 |
| T-Mobile USA | Issue 1-1: Option 1  Further input: We think that MPR defined in the n41 PC1.5 WI is overly conservative. We would support improved MPR for n77, n78 and n79 that would also be available for PC1.5 in all bands including n41 and signalled via modifiedMPRbehavior. |
| LGE | **Issue 1-1: Option 1 or option 3 is OK** |
| CMCC | Issue 1-1: MPR is a general requirements, The same MPR should be applied to the NR band of n77 n78 and n79, We agreed to re-evaluate the MPR requirements if there is room to tighten it.  We prefer option3. |
| Qualcomm | Issue 1-1: We think the MPR even for smartphone should be improved to be able to obtain the benefit from PC1.5. Therefore, we support option 3. |
| HW | Issue 1-1: Option 1 |
| Verizon | **Issue 1-1:** Option 3  New isolations in requirement have been considered and discussed by companies. RAN4 needs to study more for the UE RF assumption and improve the A-MPR and MPR for the 29dBm smartphone. |
| Apple | Issue 1-1 Option1: The MPR for PC1.5 applies to Band n77, n78 and n79 |
| Vivo | **Issue 1-1:** Option 1 |

Sub topic 1-2: FWA MPR

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| **Company** | **Comments** |
| Skyworks | Issue 1-2: in order to assess MPR reuse or nor. Or even if the improvement is worth the effort, Assumptions for FWA should be discussed and agreed |
| T-Mobile USA | Issue 1-2: ~~Option 1~~ Option 2. FWA can have different assumptions than a smartphone. |
| LGE | The detail parameters shall be determined based on RAN4 consensus. |
| Qualcomm | Option 2. An FWA is different from a smartphone, so the same assumptions and conclusions should not be blindly applied, especially when the potential impact to performance is so large. |
| HW | Issue 1-2: Option 1. MPR is allowance and it does not cap the UE performance. Option 1 has the benefit of enabling a broad range of design options for a variety of use cases and potentially reaching out to more users. |
| Verizon | **Issue 1-2:** Option 2  New isolations in requirement have been considered and discussed by companies. RAN4 needs to study more for the FWA RF assumption and improve the A-MPR and MPR for the 29dBm FWA. |
| Apple | Issue 1-2: Option1: As FWA devices appear to the network similar to normal UEs the same MPR has to be reused. Also, a device does not have to use the MPR to its max but can use less if it is not limited by emission issues. |
| Vivo | Issue 1-2: Option 1 |

Sub topic 1-3: UE RF requirements for Band n79

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| **Company** | **Comments** |
| Skyworks | P1 and 3: Agree  P2: If 2T/4R is assumed this should be the case.  P4: need to agree which coexistence requirement is an issue?: radio altimeter in 4-4.2GHz? coex with n77? |
| LGE | Issue 1-3: Support Moderator proposal 1,2 and 3. For the P4, the RAN4 can study whether or not define additional coexistence requirements based on the regional regulation, if needed. It should be provided the detail additional requirements from proponent. |
| CMCC | Support P1, P2 and PC3  For P4, prefer option 1: No A-MPR for Band n79 |
| Qualcomm | Agree with proposals 1, 2, and 3. For proposal 4, it would be better to study to make sure there are no issues due to the higher power. |
| Huawei | Issue 1-3: P1, 2 and 3 are agreeable. As for P4, A-MPR could always be requested if coexistence issue is identified later. |
| Apple | Issue 1-3:  Proposal 1: Agree  Proposal 3: Agree  Proposal 4: Regarding the current coexistence requirements for n79 the closest protected region is band 42. If new coexistence requirements shall be introduced, then A-MPR might be needed. |
| Vivo | Support P1, P2 and P3. |

Sub topic 1-4 : Smartphone SAR

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| --- | --- |
| **Company** | **Comments** |
| Skyworks | Issue 1-4: Agree Proposal 1 |
| T-Mobile USA | Issue 1-4: Agree Proposal 1.  Further input: For Proposal 2, we would need to see the different method before deciding if the network needs to be infiormed. For instance, depending on the existing mechanism. The same signalling may suffice. For instance, 100% duty cycle supported may apply to the new mechanism without the network knowing if the UE is FWA or a smartphone. |
| LGE | Support moderator proposal 1 and 2 |
| CMCC | Issue 1-4: Agree Proposal 1 |
| Samsung | We support moderator’s proposals. Either proposal 1 or proposal 2 can be taken after we decide how to handle the MPE for FWA |
| Qualcomm | Support proposal 1. For proposal 2, we can wait for the outcome of FWA MPE to see if anything is needed. |
| Huawei | Issue 1-4: P1 is agreeable. P2 is subject to further discussion. |
| Apple | Issue 1-4: Proposal 1 |
| Vivo | Issue 1-4: Agree Proposal 1 |

Sub topic 1-5: Release independence

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| **Company** | **Comments** |
| Skyworks | Issue 1-5: this may differ for smartphone or FWA. |
| LGE | Prefer option 2 |
| CMCC | Referring to the description of NR UE power class in TS38.307, the feature of TDD power class 1.5 can be supported form Rel-15 by release independent manner.  Support option 1: PC 1.5 for n77, n78, and n79 are release independent to R15 |
| Qualcomm | Option 2. There is no urgency to conclude on release independence now at this meeting. |
| Huawei | Issue 1-5: Option 1. |
| Verizon | Issue 1-5: Option 2 |
| Apple | Option 2 |
| Vivo | Prefer option 2. |

### CRs/TPs comments collection

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

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| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2105013**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105013.zip)  Draft CR on PC1.5 UE RF requirements of n79 in Rel-17 TS 38.101-1 (CMCC) | Company A |
| Company B |
|  |
| [**R4-2105010**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105010.zip)  Draft CR on PC1.5 HPUE SAR issue into Rel-16 TS 38.101-1 (CMCC) | *Moderator note: This is a Rel-16 correction, not on the agenda for RAN4 #98-bis-e.*  *Suggest “not treated”* |
| [**R4-2105011**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105011.zip)  Draft CR on PC1.5 HPUE SAR issue into Rel-17 TS 38.101-1 (CMCC) | *Moderator note: This is a Rel-16 correction, not on the agenda for RAN4 #98-bis-e.*  *Suggest “not treated”* |

## 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:* |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **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)

# Topic #2: RF exposure aspects for FWA

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2105035**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105035.zip) | Samsung | MPE handling for high power FWA devices  **Observation 1: The method of evaluating RF exposure to human body is highly dependent on the device type and deployment scenarios.**  **Observation 2: For UEs for FWA operations, the device can be determined as maintained 20 cm separation distance to the body at least, and the MPE criteria are applied as the evaluation parameters.**  **Observation 3: A FWA device having a lower antenna gain might meet the RF exposure regulation in general without the duty cycle scheme nor other solutions.**  **Observation 4: RAN4 should have further discussion on the for the FR1 MPE handling mechanism given the definition gap between UE power class and MPE regulatory requirements.** |
| [**R4-2107264**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107264.zip) | Huawei, HiSilicon | On the RF exposure limit for FWA PC1.5  **Observation 1**: Power class 1.5 FWA devices are likely to exceed relevant MPE regulations. However existing mechanisms such as P-MPR and/or duty cycle can be reused to facilitate MPE compliance.  **Observation 2**: The MPE compliance in FR1 has not been defined in 3GPP specs. The existing evaluation period for SAR (FR1) or MPE (FR2) is much shorter than the one specified in the FCC MPE regulation.  **Proposal 1**: Reuse the existing P-MPR and/or duty cycle mechanisms for facilitating FWA MPE compliance.  **Proposal 2**: A longer evaluation period for the duty cycle solution should be considered. |

## Open issues summary

Both paper submitted on this topic use the same equation for MPE but arrive at different conclusions.

### Sub-topic 2-1

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 2-1: FWA MPE approach**

* Proposals
  + Option 1: Duty cycle reporting is not used. Instead, focus on G\_tx assumption.
    - If actual G\_tx is larger than assumed G\_tx, then conducted power is reduced (P-MPR? Other?)
  + Option 2: Duty cycle approach is used with possible longer evaluation period.
  + Option 3: Other (please provide suggestion)
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

Sub topic 2-1: FWA MPE approach

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| --- | --- |
| **Company** | **Comments** |
| LGE | Need further discuss to open all candidate solutions |
| CMCC | Not sure if it is necessary to define SAR for FWA and need to clarify the difference between FWA and Smart UE in SAR testing so that companies can see if RAN4 need to define a new SAR method for FWA |
| Samsung | We support Option 1. However, unless a concrete method using the G\_tx can be proposed and/or agreed in the next meeting, we are also fine to reuse the existing SAR solution for the smartphone, 25% dutycycle. |
| Qualcomm | Agree with LGE, we aren’t ready to dismiss either option yet. Perhaps some elements of both can be used in the end, rather than either/or. |
| Huawei | Issue 2-1: FWA MPE  Similar to SAR issue, MPE compliance is UE’s responsibility. Hence the P-MPR method should be the baseline and mandatory, while duty-cycle or other schemes are optional and need further study. |
| Verizon | Agree with LGE! |
| Vivo | We don’t see the reason to exclude duty cycle solution. When actual G\_tx is larger than assumed G\_tx, both P-MPR and duty cycle approach are optional approaches for MPE. |

### 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** |
|  | Company A |
| Company B |
|  |
|  | 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:* |

### 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)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
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Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents