**3GPP TSG-RAN Meeting #93-e RP-212548**

**Electronic Meeting, September 13 – 17, 2021**

**Agenda item:** 9.1.4

**Source:** RAN4 chair (Huawei)

**Title:** Moderator's summary for discussion [93e-08-RAN4-R17-Spectrum]

**Document for:** Information

# Introduction

In this email thread we will discussion the following topics:

* New WI proposal for APT 600MHz NR band
* New WID on high power UE (power class 2) for NR FDD band (SI was closed and this is follow-up WI)
* New WID on increasing UE power high limit for CA and DC
* “Improved MSD” and “lifting the restriction on MOP imposed by PC“

The following contributions will be covered.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **TDoc** | **Title** | **Source** | **Type** | **AI** |
| [RP‑211744](file:///C:\\Users\\d00375225\\AppData\\Local\\Temp\\Rar$EXa6264.33390\\docs\\RP-211744.zip" \t "_blank) | APT 600MHz NR band | Spark NZ Ltd | Discussion |  |
| [RP‑211903](file:///C:\\Users\\d00375225\\AppData\\Local\\Temp\\Rar$EXa6264.33390\\docs\\RP-211903.zip" \t "_blank) | New WID on high power UE (power class 2) for NR FDD band | China Unicom | WID new |  |
| [RP‑212163](file:///C:\\Users\\d00375225\\AppData\\Local\\Temp\\Rar$EXa6264.33390\\docs\\RP-212163.zip" \t "_blank) | New WID: Increasing UE power high limit for CA and DC | China Telecom | WID new |  |
| [RP‑212364](file:///C:\\Users\\d00375225\\AppData\\Local\\Temp\\Rar$EXa6264.33390\\docs\\RP-212364.zip" \t "_blank) | Way forward on "Improved MSD" and "Lifting the restriction on MOP imposed by PC" | Nokia, Nokia Shanghai Bell | discussion |  |

In this document, we capture comments and conclusions for this email thread.

# Topic #1: APT 600MHz NR band

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Title** | **Sourcing company** |
| [RP‑211744](file:///C:\Users\d00375225\AppData\Local\Temp\Rar$EXa6264.33390\docs\RP-211744.zip) | APT 600MHz NR band | Spark NZ Ltd |

## Initial round

### Comments & responses

**Background information**

The SI of Study on extended 600MHz NR band was completed and the LS was sent to AWG. It is expected to get feedback from AWG. The following are the related contributions. Please have discussions taking into account the following contributions.

*A study of the feasibility of various duplex filter arrangements for the extended 600 MHz band has now been completed. The TR 38.860 contains the outcome of the Study item on extended 600MHz. This has been submitted to the RAN for approval in doc RP-211766.*

*RAN 4 has sent a LS to the AWG informing them of the completion of the work. The AWG 28 is currently meeting on line 6- 14 September.*

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| --- | --- | --- |
| [RP‑211675](file:///C:\\Users\\d00375225\\AppData\\Local\\Temp\\Rar$EXa6264.33390\\docs\\RP-211675.zip" \t "_blank) | LS on the progress of the study item on extended 600MHz NR band (R4-2114750; to: Asia-Pacific Telecommunity Wireless Group (AWG); cc: RAN; contact: Spark) | RAN4 |
| [RP‑211952](file:///C:\\Users\\d00375225\\AppData\\Local\\Temp\\Rar$EXa6264.33390\\docs\\RP-211952.zip" \t "_blank) | Status report for SI Study on extended 600MHz NR band; rapporteur: Spark NZ Ltd | RAN4 |
| [RP‑211766](file:///C:\\Users\\d00375225\\AppData\\Local\\Temp\\Rar$EXa6264.33390\\docs\\RP-211766.zip" \t "_blank) | TR 38.860 v1.0.0 Study on extended 600MHz NR band | Spark NZ Ltd |

**Sub-topic 1-1: Any question or comment on the justification or any other general comment for WI?**

Companies are invited to provide the general comments, including comments on justification part, whether the WI is needed, how to handle the work, in the follow table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Examining the proposed WID, we find the following proposal to be problematic:  • Develop a technical specification for the APT 600 MHz band for options B1 and B2  Our understanding is that the two options cannot be combined, as the RF requirements associated with each option are not compatible. Furthermore, we are not yet aware of any regulatory requirements (e.g. frequency plan, emission limits, protected services, blocking requirements, etc.) emerging from APT either as a unified set or even from at least one of the APT members (in case the request were to define a nation-specific band). Without this basis RAN4 cannot define the corresponding UE and BS RF requirements.  Our further understanding is that APT is currently convened in a meeting, and an LS response to 3GPP is under development: perhaps with the possibility of sending it in time for 3GPP RAN to receive during the week. After conferring with our colleagues who are attending the APT meeting, we understand that there is not yet consensus in APT on a set of unified regulatory requirements around the 600 MHz band, with even Option A (reuse of band n71 directly) being included as a possible option. We would like to propose that 3GPP table further discussion related to the APT 600 MHz band until regulatory requirements are defined by the APT. |
| Spark NZ | The APT region doesn’t have a unified regional regulatory requirement for emissions, unlike those in EU and the US. There are various TV standards in the APT region (e.g. 6, 7, 8 MHz TV channel spacings) used. Typically APT will adopt the emission and regulatory requirements (e.g. frequency plan, emission limits, protected services, blocking requirements, etc.) used in other regions and standards bodies. The APT plenary meeting has just concluded and has approved the LS to 3GPP. The LS statement states for preference of B1 and B2 - *AWG is still considering Options B1 and B2 at this stage and will continue keeping these options under review with the objective to decide on a single option at our next AWG-29 meeting as more information becomes available.*  Section 5 of LS describes the different systems in adjacent bands and the required ITU-R regulations.  3GPP can table another LS to AWG if more information is required.  During the AWG meeting there was considerable discussion on options B1 and B2 and individual country preferences for each (for example India had a contribution preferring B1 to be developed by September-2022, New Zealand had a contribution to develop B2 by September-2022). The APT region has countries with a significant population base with varying degrees of development. The 600 MHz spectrum is extremely useful for rural broadband coverage, as some countries are facing a spectrum crunch. It is clear that different administrations may opt for B1 or B2 depending on their spectrum planning requirements. However AWG has indicated a preference for a single option by the AWG29 meeting. It must be noted that in region 3 the UHF band is already co-primary allocated for fixed, mobile and broadcasting. This gives freedom to region 3 countries to introduce mobile technologies in this range. Some may need an IMT identification and others may not need the IMT identification to introduce IMT mobile. Those countries that need an IMT identification will do so via country foot notes at WRC23. It is therefore import that this extended 600 MHz band has band plan certainty before WRC23. Similarly region 1 will review UHF band need under agenda item 1.5 at WRC23. The development of a clear band plan has therefore the potential to become a candidate option for Europe. |
| Nokia | The last paragraphs in Justification should be updated according to the latest LS draft in AWG,  “AWG is still considering Options B1 and B2 at this stage and will continue keeping these options under review with the objective to decide on a single option at our next AWG-29 meeting as more information becomes available. “ |
| Huawei | It is expected that RAN will receive LS from AWG this week, saying that both options B1 and B2 are still under investivation, with the B2a being de-prioritized by AWG. Considering AWG29 meeting time March 2022, and increasing time pressure from some parties (as per Spark comment: *India had a contribution preferring B1 to be developed by September-2022, New Zealand had a contribution to develop B2 by September-2022*), we feel that it would be good to keep work continuation in 3GPP in order not to waste valauble time before March 2022.  One possible solution is to aim for a WI approval which would include a (3/6 months) pre-Study phase, with the aim to identify the B1-, and B2-specific requirements, so that both options are on the table:   * UE RF and BS RF requiremets which are B1-, or B2-specific, as well as those band-arrangement-agnostic, etc. * Updates to the B1, or B2 regulatory preferences from interested markets, operators.   For sake of workload control, RF requirements are not to be defined until Dec 2021, where we can set a checkpoint for any further progress on B1 vs. B2 discussions in  AWG. In the meantime, we can try to check if there is any chance to reach consesnsus on a single band arrangement for APT. Afterwards, we may aim for the normative work.  WID to be limited to the non-AAS BS architecture, only. |
| Ericsson | If there is study phase during the WI then the focus should be on those requirements which are common to both options since AWG has not decided the exact option. Requirements specific to B1 or B2 should be discussed after 3GPP receives the final LS from AWG indicating the selected option by AWG. |
| Skyworks | It is unusual to develop the specification for two band configurations that are incompatible and targeting the same spectrum, especially the SI has discussed synergies and issues in relation to the n71 eco-system but if both band configuration B1 and B2 are specified then the only chance of reuse is to enable dual duplexer solution in B1 and B2 such that at least n71 duplexer is used in both solutions |
| Telstra | We also note that there is an incoming LS from AWG to RAN and companies in RAN have not had the opportunity to see this LS yet before the initial round deadline. The LS needs to be included in the Background information when it becomes available.  It is also our understanding that according to the LS, AWG makes it clear it is still considering Options B1 and B2 and a decision on a single option will be made at their next AWG-29 meeting. Telstra feels it is premature to start normative work until AWG comes to a conclusion on a single option for the band before initiating normative work. |
|  |  |

**Sub-topic 1-2: Can we start the work based on options B1 and B2**

The proponent proposed that

* ***The objective of the WI is to request the 3GPP to start normative work on options B1 and B2.***

Can we agree on this proposal? Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We think it is premature and inefficient to start a work item to define a new band with both options B1 and B2. We just sent the LS to AWG and should await their response and downselection before 3GPP starts a new band WI to avoid unnecessary work. |
| Apple | In our assessment, 3GPP cannot start any work on the APT 600 MHz band until the related regulatory requirements become available. |
| Spark NZ | As above, we have commented on the regulatory requirements.  A lot of momentum was developed to conclude the SI and this involved a positive collaborative effort. It would be good to carry on this momentum, and not have a pause.  While AWG is deliberating over options B1 and B2 we could consider common aspects associated with B1 and B2 (that will impact the normative work) so that valuable time is not lost.  AWG has requested for the band plans to be completed, by September-2022.  The 600 MHz frequency range doesn’t lend itself to adaptive antenna arrays. Whether it is B1 or B2 the base-stations are of type 1C and not AAS base-stations. We should discuss and agree to this. The study item concluded the UE antenna efficiency was not considered, which could also be reviewed under this WI. We may also discuss the UL / DL compatibility and how it applies to B1 or B2. |
| Intel | In our understanding the AWG is still discussing whether both option B1 and B2 shall be considered or whether a single option shall be selected. In our view 3GPP shall define any new band once there is a clear regulatory decision for such a band, but not to try to pre-empt and possibly influence such decisions. Therefore, our preference is wait for a clear decision from regulatory bodies before proceeding the band definition and come back to the WI approval in December plenary meeting. |
| Nokia | We support to work on both options until AWG makes a recommendation. |
| Huawei | We do expect the LS from AWG to be received by RAN this week. It seems that it is already well known that the LS will consider both options B1 and B2 (we need to wait for the formal LS to be received by RAN this week).  As in sub-topic 1-1, we suggest to start with WI with the pre-study phase (i.e. not to start the normative work for both options right now), to allow the RF requirements identification discussion in RAN4.  We suggest not to wait with any further action until the next AWG-29 (March 2022). This would create significant stress to aim for the normative work completion by Sept 2022, as requested by AWG. |
| Ericsson | It is also our understanding that AWG has not yet decided between options B1 and B2. So until we receive final LS from AWG, any RAN4 work on 600 MHz should focus on requirements which are generic to both options. |
| Skyworks | Our preference is to start the work only when a single band configuration is available from AWG |
| Telstra | It is also our understanding that according to the LS, AWG makes it clear a decision on a single option will be made at their next AWG-29 meeting.  Telstra agrees it is premature to start normative work until AWG comes to a conclusion on a single option for the band before initiating normative work. RAN4 does not have the luxury to do normative work on speculative options. |
| CBN | We share similar view with Huawei. Considering AWG29 meeting time March 2022, we think it would be good to have a dedicated WI for APT 600MHz in 3GPP in order not to waste time before March 2022. |

**Sub-topic 1-3: Comments and responses on the proposed objectives**

The following objectives are proposed in the WID.

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**Core part:**

The purpose of this work item is to:

Develop a technical specification for the APT 600 MHz band for options B1 and B2 as shown below:

Table 1: NR operating band (option B1)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Operating Band | Uplink (UL) operating band BS receive UE transmit | | | Downlink (DL) operating band BS transmit  UE receive | | | Duplex Mode |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
|  | 663 MHz | – | 703 MHz | 612 MHz | – | 652 MHz | FDD |

Table 6: Duplexer arrangements (option B2 35+25)

|  |  |  |  |
| --- | --- | --- | --- |
| Duplexer type | Uplink (UL) operating band BS receive UE transmit | Downlink (DL) operating band BS transmit  UE receive | Duplex Mode |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| Duplex 1  Duplex 2 | 663 MHz – 698 MHz  678 MHz – 703 MHz | 617MHz – 652 MHz  632MHz – 657 MHz | FDD |
| FDD |
| NOTE: Both duplexers will be part of the same band | | | |

The above specifications should include the following

* Operating band, channel bandwidth and system parameters
* BS and UE RF core requirement taking into account potential coexistence issues
* RRM requirement

**Perf. part**

The objectives are to define:

* Conformance requirements for BS

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Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | See comment above |
| Apple | Examining the proposed WID, we find the following proposal to be problematic:  • Develop a technical specification for the APT 600 MHz band for options B1 and B2  Our understanding is that the two options cannot be combined, as the RF requirements associated with each option are not compatible. Furthermore, we are not yet aware of any regulatory requirements (e.g. frequency plan, emission limits, protected services, blocking requirements, etc.) emerging from APT either as a unified set or even from at least one of the APT members (in case the request were to define a nation-specific band). Without this basis RAN4 cannot define the corresponding UE and BS RF requirements.  Our further understanding is that APT is currently convened in a meeting, and an LS response to 3GPP is under development: perhaps with the possibility of sending it in time for 3GPP RAN to receive during the week. After conferring with our colleagues who are attending the APT meeting, we understand that there is not yet consensus in APT on a set of unified regulatory requirements around the 600 MHz band, with even Option A (reuse of band n71 directly) being included as a possible option. We would like to propose that 3GPP table further discussion related to the APT 600 MHz band until regulatory requirements are defined by the APT. |
| Spark NZ | We have commented on the regulatory requirements above.  We’ve also provided some example items of WIs that we may undertake for the Core / performance parts that are common to both B1 and B2, while awaiting a decision from AWG. |
| Nokia | The passband bandwidth of duplex 2 in B2 option is a UE implementation issue and may not need to be specified at this stage since it depends on the required maximum channel bandwidth of the band. If the maximum channel bandwidth of the band is already decided to be 25 MHz or less, this assumption is ok, however, if 30 MHz channel bandwidth is required, duplex 2 passband bandwidth needs to be extended to 30 MHz.  It is proposed to add a note in objective part the number of band(s) to be defined depends on further recommendation from AWG |
| Huawei | We suggest to add a pre-study phase to the WID, with the aim to identify the B1-, and B2-specific requirements, so that both options are on the table. For sake of workload control, RF requirements are not to be defined until Dec 2021, where we can set a checkpoint for any further progress on B1 vs. B2 discussions in  AWG.  BS part to be limited to non-AAS BS architecture. |
| Ericsson | We are fine to work on common aspects of B1 and B2 and study phase can be better option. |
| Skyworks | The proposal seems to indicate single duplxer for B1 and dual duplexer for B2 but then there is nothing in common for the two. The work should only start once single band configuration is agreed in AWG |

**Sub-topic 1-4: Comments and responses on impacted/new specifications and target completion date & time budget**

The proposed impacted specifications as well as target completion date are as follows:

(Moderator: the Rel-17 target completion date is March 2022 RAN#95 for Core part)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **New specifications** *{One line per specification. Create/delete lines as needed}* | | | | | |
| Type | TS/TR number | Title | For info  at TSG# | For approval at TSG# | Remarks |
| *Internal TR* | *38.xxx* | APT 600 MHz NR band | *TBD* | *RAN#* |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Impacted existing TS/TR** *{One line per specification. Create/delete lines as needed}* | | | |
| TS/TR No. | Description of change | Target completion plenary# | Remarks |
| 38.101-1 | NR; UE Radio transmission and reception | RAN#97 | Core part |
| 38.133 | NR; Requirements for support of radio resource management | RAN#97 | Core part |
| 38.104 | NR; BS Radio transmission and reception | RAN#97 | Core part |
| 38.141-1 | NR; Base Station (BS) conformance testing Part 1: Conducted conformance testing | RAN#97 | Perf. Part |
| 36.104 | E-UTRA; BS Radio transmission and reception | RAN#97 | Core part |
| 36.141 | E-UTRA; BS conformance testing | RAN#97 | Perf. Part |
| 37.104 | E-UTRA, UTRA and GSM/EDGE; Multi-Standard Radio (MSR) Base Station (BS) radio transmission and reception | RAN#97 | Core part |
| 37.141 | E-UTRA, UTRA and GSM/EDGE; Multi-Standard Radio (MSR) Base Station (BS) conformance testing | RAN#97 | Perf. Part |
| 37.105 | Active Antenna System (AAS) Base Station (BS) transmission and reception | RAN#97 | Core part |
| 37.145-1 | Active Antenna System (AAS) Base Station (BS) conformance testing; Part 1: conducted conformance testing | RAN#97 | Perf. Part |
| 37.145-2 | Active Antenna System (AAS) Base Station (BS) conformance testing; Part 2: radiated conformance testing | RAN#97 | Perf. Part |

Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Completion date may need to be adjusted depending on when the work item starts and whether the objectives are modified. |
| Apple | Because APT has not yet converged on regulatory requirements related to this band, it is premature to set a target date for the conclusion of the 3GPP work. The only known parameter is that 3GPP RAN can discuss the scope of the related work item and consider approving it after these regulatory requirements become known. |
| Spark NZ | From LS - *AWG kindly invites 3GPP to finalize the relevant specifications by September 2022, and requests 3GPP to respond upon the feasibility of this request.*  We may comment on the feasibility of this date in a LS back to AWG |
| Nokia | Can WI be started with Rel-17 and changed to Rel-18, if its completion date is after Rel-17 freeze? Or should it be a Rel-18 WI? |
| Huawei | RAN#97 is scheduled Sept 2022 – the AWG- requested date of the future work completion. In order to respect the request from AWG, we can use this as starting point. If needed, the dates can be further adjusted by WID revisions in future, depending on the work progress, any further AWG updates, etc.  Internal TR completion date can be set as RAN#97 for now, as well (for Information at RAN#96). |
| Ericsson | I year time plan is ok. But we may have to update the timeline after receiving the final LS as this will indicate the amount of remaining work. |
| Skyworks | For completion date we need to have a single option to work on which would require less effort |
| Telstra | We agree that the completion date may need to be updated when the WID is ready for approval. This will need to take into account the final scope of work. |

### Summary

Moderator summarizes discussion status for initial round, list all the identified open issues and tentative agreements or candidate options and suggestion for next round.

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| --- | --- |
|  | **Status summary** |
| **Sub-topic #1-1 General and Sub-topic #1-2 Options B1 and B2** | 10 companies commented.  Regarding regulation, Apple raised the concern that there is no unified regulatory requirements around 600MHz band as reference to finalize the RF requirements. Spark NZ responded that APT region does not have a unified regulatory requirements and various TV standards in APT region which can be referred to by 3GPP. It seems that regulation is not a hurdle.  The information was provided that AWG LS will be sent to 3GPP in this week. In the LS, it stated that *WG is still considering Options B1 and B2 at this stage and will continue keeping these options under review with the objective to decide on a single option at our next AWG-29 meeting as more information becomes available.*  How to proceed the work, there were two camps. One camp thought it is pre-mature to start the WI and 3GPP should wait for AWG to do down-selection between Options B1 and B2. The other camp proposed to start WI based on B1 and B2 with a study phase and setting a check point for progress on B1 and B2 in AWG.  **Tentative agreements:**  None  **Candidate options:**  To proceed, moderator suggests to further discussion the following alternative solutions:   * Alternative 1: Do not start a WI until 3GPP receives the AWG decision on a single option between B1 and B2. * Alternative 2: Start a WI with study phase and checking point for AWG decision   + During study phase, RAN4 should focus on generic requirements for both B1 and B2 and identify which requirement specific for B1 and B2 respectively.   + Start the normative work for RAN4 requirements after receiving AWG decision   **Recommendations for intermediate round:**  Further discuss the following two alternative solutions in the intermediate round. |
| **Sub-topic #1-3 Objectives** | 7 companies commented. Companies expressed the concern on starting the work. Besides, Nokia had comment on duplex 2 passband bandwidth, which is related to the target maximum channel bandwidth for the targeting band. Huawei commented that BS part should be limited to non-AAS BS architecture.  **Tentative agreements:**  None.  **Candidate options:**  None.  **Recommendations for intermediate round:**  The objectives can be discussed after we reach consensus on whether to approve the work item. If the group agreed on starting a WI, then the comments from Nokia and Huawei need be captured. |
| **Sub-topic #1-4 Impacted spec and timeline** | 8 companies commented. Companies still expressed the concern on starting the work.  Besides, Spark NZ proposed to set the completion date as September 2022 the same date as AWG invite 3GPP to finalize the work, and Ericsson agree with it. Nokia commented whether it should be Rel-18 or Rel-17 WI. Other companies thought the completion date should be updated when WID is ready for approval.  **Tentative agreements:**  It seems proponent and other supporting companies tend to set target completion date at September 2022. So the tentative agreement would be   * If the WI is agreeable in RAN#93e, then the target completion date will be September 2022.   Then in moderator understanding, this WI will be Rel-18 spectrum related WI.  **Candidate options:**  None  **Recommendations for intermediate round:**  The target completion date will be decided after we reach consensus on whether to approve the work item. |

## Intermediate round

### Comments & responses

**Sub-topic #1-1 General and Sub-topic #1-2 Options B1 and B2**

In the intermediate round, companies are encourage to comment on how to proceed the work for 600MHz spectrum considering the following alternative solutions and the incoming LS from AWG.

* Alternative 1: Do not start a WI until 3GPP receives the AWG decision on a single option between B1 and B2. (Apple, Skyworks, Telstra, Qualcomm, Intel)
* Alternative 2: Start a WI with study phase and checking point for AWG decision (Spark NZ, Nokia, Huawei, Ericsson, CBN)
  + During study phase, RAN4 should focus on generic requirements for both B1 and B2 and identify which requirement specific for B1 and B2 respectively.
  + Start the normative work for RAN4 requirements after receiving AWG decision

The target is to reach the consensus on whether and how to start the work item. Based on the agreement the objectives and completion date will be further discussed and decided in the final round.

Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Our preference is alternative 1 for now, but we’d like to understand what specifically are the generic requirements common to both B1 and B2. |
| Apple | Alternative 1 is fine for us, although it is not accurate in light of the following information in the LS from APT:    In our understanding, if APT does not reach consensus on the next revision of APT Report 79, then the only option which 3GPP can consider is Option A (which is reuse of band n71).  We would also like to comment on the proposed study phase: in our understanding, the just-concluded study item was the study phase in 3GPP, and all relevant outcomes are captured in a technical report. The only uncertainty which remains are the regulatory requirements, such as frequency plan, emission levels, protected services and limits, and blocking requirements. These requirements are the necessary input to 3GPP before a new band can be defined, and we don't see how a study phase can help us determine this information in 3GPP. In our understanding, this normative information needs to come from regulators: either from APT as a whole or from individual members of APT. |
| Spark NZ | Spark prefers Alternative 2.  Identifying generic aspects for B1 and B2 in 3gpp recommendations shouldn’t take too much time resources in RAN4. For example the bulk of 38.104 is generic to B1 and B2. The Tx/Rx RF conditions for sub 1GHz bands would apply here. Similairly per 38.101 the bulk of this would also apply to B1 and B2. With the exception of UE OOBE requirements that were specifically determined for n71.  As pointed in our prior comments in the initial round there is a need to look at UE antenna efficiency this is also generic to B1 vs B2. Therefore we believe this phase of the work while we await the AWG decision should involve a check of all the relevant 3GPP recommendations and their content with a view of identifying what part will be generic (as per Qualcomm’s suggestion). This will give us a head start when we here from the AWG in March/April-2022. We respectfully ask colleagues to show a spirit of collaboration so that we can work together as we did in completing the study item.  As for specific regulatory requirements such as listed in the comment by Apple, regardless of whatever option is preferred by the AWG, the following scenario will apply;  The APT does not have a unified regulatory regime for unwanted emissions nor is it likely to develop one in the near future. APT does not normally set specific requirements for the region. Instead APT members normally follow the requirements of broader international requirements (e.g. ITU Radio Regulations and ITU-R Recommendations or Reports) or use the requirements from other regions such as Europe or the Americas. It is noted that Europe, regulatory regime is contained within various Decisions and recommendations.(e.g. Block Edge Mask through ECC and EU decisions and spurious emission limits through ERC Recommendation 74-01) The US has requirements in regulations which other countries may also follow. 3GPP specifications are normally written to fit within the envelope of the ITU, European and US requirements therefore these would likely be also appropriate for many APT countries. It should also be noted that TR 38.860 provides unwanted emission limits comparable to that of N71 where incumbent services were taken into account.  Therefore lack of regulatory conditions as suggested by Apple should not be considered a blocking point for commencing the work. |
| Intel | Our preference is Alternative 1 we prefer to wait for AWG decision |
| Telstra | Our preference is alternative 1 |
| Nokia | We support alternative 2. Justification and Objective of WID should be revised as we commented in the first round. The workplan (including the study phase) can be further discussed in the final round |
| CBN | CBN prefers Alternative 2. |
| ZTE | We support alternative #2. In this constructive way, we can start real works before AWG’s final decision is available. |
| Skyworks | We continue our support to alternative 1, moreover we do not see what we would gain with alternative 2 as we would have to look into “generic” requirements for two band options. Most of the study work was done in SI anyhow and we certainly would not do any further work on filter characteristics for two options. Finally the most difficult part will be related to band specific aspects and MSD which needs to single option on the table |
| Huawei | Alternative 2 preferred.  The pre-study phase, or the generic work were to proceed with multiple requirements which are simply band-agnostic. We do agree that the most difficult part is expected to be the band-specific, related to MSD, or blocking requirements.  Considering the feedback from other companies above, we would like to stress again on multiple requests to complete the work by Sept 2022. Furthermore, RAN should also recognize that various APT countries have varying preferences among B1 and B2 – we should not preclude the need to specify both options in future WI, depending on the AWG feedback by March 2022.  We should inform AWG in LS about the timeline implications: if we need to wait for the decision till March 2022, it may not be possible to complete the work by Sept 2022. AWG members shall be informed about such risk.  We would like to also point out, that we do not share Apple’s understanding on the Option A being the fallback solution (in case APT does not reach consensus on the next revision of the APT Report 79). |
| Ericsson | As yet another alternative to Alternative 2, we could consider continuing the study item in RAN4 studying outstanding issues on B2 performance with the 6 MHz duplex gap and the UE antenna performance for all options. That’s the 600 MHz SI is kept open. |

### Summary

Moderator summarizes discussion status for this round, list all the identified open issues and tentative agreements or candidate options and suggestion for next round.

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #1-1 General and Sub-topic #1-2 Options B1 and B2** | **Topic #1: APT 600MHz NR band**  The situation is unchanged in intermediate round compared to previous round. Almost half of companies supported a new WI while the other half were against. The situation is as follows:   * Alternative 1: Do not start a WI until 3GPP receives the AWG decision on a single option between B1 and B2. (Apple, Skyworks, Telstra, Qualcomm, Intel) * Alternative 2: Start a WI with study phase and checking point for AWG decision (Spark NZ, Nokia, Huawei, Ericsson, CBN)   + During study phase, RAN4 should focus on generic requirements for both B1 and B2 and identify which requirement specific for B1 and B2 respectively.   + Start the normative work for RAN4 requirements after receiving AWG decision   Moderator would like to propose the following compromise solution.   * **Proposal #1**: Approve a WI for APT 600MHz NR band in RAN#93e but put it on hold until 3GPP receives the information about decision on options for band plan in AWG-29 in March 22.   **GTW discussion on Wednesday:**  Companies still had concern on Proposal #1. Ericsson proposed to extend SI. So there are three alternatives which can be discussed further in final rounds.   * Alternative 1: Do not start a WI until 3GPP receives the AWG decision on a single option. (Apple, Skyworks, Telstra, Qualcomm, Intel) * Alternative 3 (Proposal #1 in intermediate round: Approve a WI for APT 600MHz NR band in RAN#93e but put it on hold until 3GPP receives the information about decision on options for band plan in AWG-29 in March 22. * Alternative 4: Extend the SI which is to be closed in RAN#93-e to March 22 to continue discussion on options based on the feedback of AWG. |

## Final round

### Comments & responses

Based on discussion in intermediate round and GTW on Wednesday, the following alternatives need discussion in final round.

Companies still had concern on Proposal #1. Ericsson proposed to extend SI. So there are three alternatives which can be discussed further in final rounds.

* Alternative 1: Do not start a WI until 3GPP receives the AWG decision on a single option. (Apple, Skyworks, Telstra, Qualcomm, Intel)
* Alternative 3 (Proposal #1 in intermediate round: Approve a WI for APT 600MHz NR band in RAN#93e but put it on hold until 3GPP receives the information about decision on options for band plan in AWG-29 in March 22.
* Alternative 4: Extend the SI which is to be closed in RAN#93-e to March 22 to continue discussion on options based on the feedback of AWG.

**Question: Can we go with Alternative 4? If not any suggestion how to move forward?**

Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Alternative 3 could be acceptable depending on the contents of the WID. It is similar to the approach that was used for 6 GHz bands. For alternative 4, we’re not sure what discussions would be extended since the SI has already been closed and objectives met. Filters have already been studied extensively. We don’t want to keep TU’s reserved if there is no real work to be done. |
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### Summary

Moderator summarizes discussion status and provide the recommendation.

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| --- | --- |
|  | **Status summary** |
| **Sub-topic #1-X XXX** | Recommendations: |
|  |  |
|  |  |

# Topic #2: HPUE PC2 for NR FDD band

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Title** | **Sourcing company** |
| [RP‑211903](file:///C:\Users\d00375225\AppData\Local\Temp\Rar$EXa6264.33390\docs\RP-211903.zip) | New WID on high power UE (power class 2) for NR FDD band | China Unicom |

## Initial round

### Comments & responses

**Background information:**

The SI of Study on high power UE (power class 2) for one NR FDD band was completed. The related documents are provide below. This proposed WI is the follow-up work item.

|  |  |  |  |
| --- | --- | --- | --- |
| [RP‑211854](file:///C:\\Users\\d00375225\\AppData\\Local\\Temp\\Rar$EXa6264.33390\\docs\\RP-211854.zip" \t "_blank) | Status report for SI Study on high power UE (power class 2) for one NR FDD band; rapporteur: China Unicom | RAN4 | WI status report |
| [RP‑212495](file:///C:\\Users\\d00375225\\AppData\\Local\\Temp\\Rar$EXa6264.33390\\docs\\RP-212495.zip" \t "_blank) | TR 38.861 v2.0.1 Study on high power UE (power class 2) for one NR FDD band | China Unicom | draft TR |

In this section, we collect the comments and responses for the proposed work item. Based on the comments, we will decide how to move forward in the next step.

**Sub-topic 2-1: Any question or comment on the justification or any other general comment for WI?**

Companies are invited to provide the general comments, including comments on justification part, whether the WI is needed, how to handle the work, in the follow table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | Support the following work item considering the outcome of SI, and one clarification question, is this for Rel-17 or Rel-18? |
| LGE | RAN4 can start the WI for PC2 FDD band UE with 2Tx RF architecture in Rel-17. Then 1Tx RF architecture will be discussed in future when the enhancement of the linearity performance of some RF components such as Duplexer, PA are available to support high power in FDD band. |
| Apple | We have a few questions for clarifications:  1. Should this WID be considered as a spectrum WID or non-spectrum WID? In our view, this should belong to a non-spectrum WID as there are generic SAR issue which needs to be considered for FDD bands where the concept of duty-cycled UL has not been clarified during the SI phase.  2. It was also not clarified during the SI phase as whether there would be UL performance gain when comparing PC2 UE with 50% duty cycle and PC3 UE with 100% duty cycle and 50% UL allocation where both UEs should assume the same UL coverage as their UL power spectral densities (PSD) are the same.  3. For n3, there would be substantial REFSENS degradation if UL allocation is not restricted at 50 RB. Therefore, whether there would be UL performance gain for HPUE with 50% duty cycle as compared to PC3 also needs to be clarified.  We also have the following comments:  1. New design of duplexers and multiplexers for band combinations may be needed to accommodate higher UL transmission power which could impact the smart phone ecosystem substantially.  2. Half-duplex operation in HPUE domain as proposed in R4-2110163 should be considered as an alternative solution for FDD bands as it is by nature duty-cycled which has inherently resolved the SAR issue under HPUE scenario. Half-duplex operation also allows bypassing the high insertion loss duplexer and avoids REFSENS impact from transmit leakages which can save UL from RB allocation restriction for FDD bands with narrow duplex distance. |
| Telecom Italia | Support the WI in Rel 17 or Release independent way |
| Vodafone | We also support the WI for Rel 17 or in a release independent way. |
| ZTE | We support this WI with the foundation already built in the SI stage. |
| Huawei, HiSilicon | All the issues identified in the SI have been studied. P-MPR is the baseline SAR solution. Specifically for band n1 and n3, the main requirements to be addressed in WI are MSD values. We think the WI is a follow up work for FDD HPUE for these two bands, and the expected workload is not very high to complete the work in Rel-17. |
| MediaTek | Since work loading is not low in RAN4 at this stage, further clarification can let us know the scope and work loading. We wonder whether this is for Rel-17 or Rel-18?  In addition, we think alternative solution from R4-2110163 should not be precluded because it is hard for us to neglect its’ advantage. |
| China Unicom | We would like to provide following clarifications:  1. The WID is proposed as a Rel-17 item.  2. HPUE related WI/SIs in RAN4 had been categorized as spectrum related works. The SAR issue in the case of FDD PC2 will be solved by UE-implementation based method, with no standardization work needed. Only band specific requirements are needed for specific bands (i.e. n1, n3). So in our view, the FDD PC2 HPUE WI is a spectrum work.  3. The FDD PC2 takes advantage of burst-like/discontinuous behavior of UL traffic, where the UL data can be transmitted in the high-power duration with larger PSD. The system performance gain was also verified by simulations and concluded in TR38.861.  4. If there are potential solutions to solve SAR issues for FDD PC2 HPUE based on RAN4 consensus, they can be discussed on how to standardize in the WI stage. |
| Ericsson | We are fine with the justification part and motivation. |
| Samsung | We also have comments for the clarification. In our understanding, all the HPUE SI/WIs which have been studied in 3GPP have dedicated solutions to handle the SAR issue. However, even though the justification says we have the consensus during the SI phase, we are not sure what the UE-implementation based method is, or what to do from network to support this feature. Without such clarification, it would be not easy even for the WI discussion.  For the interference handling scheme, in our understanding, MSD is not a solution, but a requirement when it is supported meaning that the large MSD for other bands might impact the overall benefit in the end. If it’s not acceptable by operators in the future, the feature would be nothing. |
| Skyworks | We mainly have comments on architecture assumptions and spectrum:  In our view it is not practical to target PC2 2Tx for FDD bands with UL <1.7GHz  For this reason 1Tx should be the baseline architecture assumption and 2Tx only an option for UL >1.7GHz.  We do not see the reason to revisit MPR for PC2 for both 1Tx and 2Tx but see A-MPR and MSD as the main issue. |
| Telstra | We support the proposal and prefer it is delivered in a release agnostic manner |
|  |  |

**Sub-topic 2-2: Comments and responses on the proposed objectives**

The following objectives are proposed in the WID.

----------------------------------------------------------------------------

**Core part:**

The objectives of the core part are as follows:

* Introduction of NR band n1 and n3 to support high power UE (Power class 2)
* Specify RF characteristics for n1 and n3, including:

1. Specify UE maximum output power, Tx power tolerance for band n1 and n3.
2. Specify A-MPR requirements for band n1 and n3 if needed
3. Specify PC2 MSD requirements for NR band n1.
4. Specify PC2 MSD requirements for NR band n3.

**Perf. part**

Specify the necessary performance requirements such as release independence in TS 38.307.

-----------------------------------------------------------------------------

Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | Contents are ok. And the normative work should take the study item outcome into account to reduce the workload. |
| T-Mobile USA | Is this going to be a basket WI, or an initial WI followed by a basket? If not a basket we think there should only be one example band. |
| CMCC | Similar question as T-Mobile on the basket for FDD HPUE. Maybe we can create a basket WI directly? |
| Apple | 1. How to specify the configured maximum output power and how it can be verified in conformance test should be included in the objective.  2. Whether the requirements are based on 1Tx or 2Tx also need to be considered.  3. How the UL duty cycle should be determined by UE in order to fall back to PC3 when necessary.  4. To include the objective of half-duplex operation in HPUE domain for SAR and REFSENS impact mitigation. The signaling aspect for UE switching between half-duplex and full-duplex operation also needs to be defined. |
| vivo | Just a clarification question, for the WI scope, do we still consider the unsolved duty-cycle approach, which is a leftover issue of SI? |
| Telecom Italia | Ok to have a basket Work Item |
| Vodafone | Contents are ok. Basket WI makes sense. |
| Nokia | It is better to focus on completing one band or the two bands studied in the SI. Then, later we discuss how to handle other bands, though it is likely to use a basket WI approach. |
| ZTE | We are fine with the objective proposals. Since both n1 and n3 are studied in the SI stage, we support to include n1 and n3 into the WI. |
| Huawei, HiSilicon | We are fine with the proposed objectives for the WI. Regarding basket or not, we think basket can be further considered in Rel-18, and finish the band specific requirements for n1 and n3 in Rel-17. |
| MediaTek | We are fine to several suggestions from Apple. We think to include the objective of half-duplex operation should not be precluded. |
| China Unicom | We would like to provide following clarifications:  1. UE-implementation based method (P-MPR) will be used for SAR compliance for Rel-17 FDD PC2 HPUE.  2. Conformance testing is related with RAN5, if needed.  3. 2Tx architecture is considered for this Rel-17 WI, as assumptions for 1Tx architecture for FDD PC2 is not yet available.  4. For FDD PC2, we plan to have a follow-up Rel-17 WI from the SI first, and then a Rel-18 basket WI is planned to be submitted for December RAN4 package. |
| Ericsson | In principle we are fine with the objectives. Current wording can be interpreted as if requirements other than those listed below are also needed. To prevent this possible misinterpretation, we suggest to modify the wording as follows (changes in yellow).   * Introduction of NR band n1 and n3 to support high power UE (Power class 2) * Specify the following RF characteristics for n1 and n3~~, including~~:  1. Specify UE maximum output power, Tx power tolerance for band n1 and n3. 2. Specify A-MPR requirements for band n1 and n3 if needed 3. Specify PC2 MSD requirements for NR band n1. 4. Specify PC2 MSD requirements for NR band n3. |
| Samsung | It would be better to capture that the requirements in the objectives are assumed with 2Tx. Also, as mentioned before, not sure if the single P-MPR method is beneficial to this feature which does not have the limitation at all. |
| Skyworks | Unclear if this aims at defining a generic FDD PC2 feature across all FDD bands ot only limited to bands > XX GHz. This needs to be clarified. The maximum output power should be based on PC2 and the only question is whether the tolerance is -2 or -3dB, if 2Tx is enabled as an option then it should be -3dB. we are missing the duty cycle aspects (at least the default that should be 50%) to define the power class |
| Telstra | Agree with the contents but it would be appropriate to add n5 or n28 (or both) to the normative work |
|  |  |

**Sub-topic 2-3: Comments and responses on impacted/new specifications and target completion date & time budget**

The proposed impacted specifications as well as target completion date are as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **Impacted existing TS/TR** *{One line per specification. Create/delete lines as needed}* | | | |
| TS/TR No. | Description of change | Target completion plenary# | Remarks |
| 38.101-1 | Add PC2 FDD to User Equipment (UE) radio transmission and reception | TSG#95 | Core part |
| 38.307 | Add PC2 EN-DC Requirements on User Equipment (UEs) supporting a release-independent frequency band | RAN#95 | Perf. part |

Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Apple | Propose to postpone the new WID proposal to Rel-18 to allow companies more time to further evaluate the technical essence and merit of HPUE for FDD bands. |
| MediaTek | We are fine to the new WID in Rel-18 and are willing to provide contribution about RF requirements in future. |
| China Unicom | The SAR schemes, interference issues, UE implementation & RF components, performance gain evaluations had been thoroughly studied in the SI phase. A Rel-17 WI is needed to fulfill the urgent commercial demand. |
| Ericsson | Impacted specifications are fine |
| Samsung | We have not seen the solutions during the SI. We would like to propose to postpone the new WI to Rel-18. |

### Summary

Moderator summarizes discussion status for this round, list all the identified open issues and tentative agreements or candidate options and suggestion for next round.

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #2-1 General** | 13 companies commented.  9 companies supported to start a WI. Companies had some comments.  **Regarding SAR scheme**, Apple and Mediatek proposed to further consider half-duplex operation, Vivo propose to further discuss the unsolved duty cycle approach, Samsung asked for clarification about “UE-implementation based method” and corresponding network behavior to support it, and Apple asked how the UL duty cycle should be determined by UE to fall back to PC3.  China Unicom clarify that P-MPR is “UE-implementation based method”. According to conclusion part of TR 38.861 (RP-212495), *several SAR compliance solutions are studied and discussed in RAN4, including UE-implementation based methods, reusing of existing duty-cycle reporting method, and half-duplex operation method. After careful studies and thorough discussions, the UE-implementation based methods are considered feasible*.  And OPPO commented that *the normative work should take the study item outcome into account to reduce the workload*.  In moderator view, there seems no need to re-open the topic again immediately after SI is closed. Even though re-opening the discussion, it seems difficult to have any new agreed scheme just after a very short time.  **Regarding REFSENS/MSD or interference handling**, Apple and Samsung commented that there will be a large MSD and questioned the achievable gain and how to handle it.  For how to handle the interference, it was stated in the conclusion part of approved TR 38.861 (RP-212495) *it was identified by the group that both MSD and UL configuration are possible alternatives to handle REFSENS degradation in FDD PC2*…  Regarding the MSD, the worst case is around 3dB of PC2 compared to PC3 as stated in Section 6.1 of the approved TR 38.861.  For the gain, it was stated that …*performance gain for both cell average and cell edge cases are verified under various power control parameters*… The analyses were provided in Section 8.  Apple commented whether it is s**pectrum related or non-spectrum related WI**. China Unicom responded that it is spectrum related WI.  Regarding whether it should be **Rel-17 or Rel-18** questioned by Mediatek and OPPO, and whether it should be **basket or not** questioned by a lot of operators, the proponent China Unicom responded that *for FDD PC2, we plan to have a follow-up Rel-17 WI from the SI first, and then a Rel-18 basket WI is planned to be submitted for December RAN4 package*.  Apple, Mediatek, Samsung proposed to postpone WI to Rel-18.  Regarding the **band and architecture**, LGE proposed to *start WI for PC2 FDD band UE with 2Tx RF architecture in Rel-17*, which China Unicom and Samsung agreed with. Apple also commented which architecture should be considered.  **Tentative agreements:**  None.  **Candidate options:**   * Approve a spectrum related WI for FDD PC2 high power UE in Rel-17   + Covering NR band n1 and n3   + Based on UE-implementation based solution, i.e., P-MPR solution, for SAR issue   + Based on 2Tx architecture   + Taking all the outcome from SI captured in TR 38.861 into account * Discuss the basket work item to cover other FDD PC2 bands in Rel-18   **Recommendations for intermediate round:**  Further discuss the above proposals. |
| **Sub-topic #2-2 Objectives** | 16 companies commented.  Operators commented whether to have a basket WI. And Skyworks proposed bands and UE architecture. Apple and Mediatek proposed to consider half-duplex. All of them were covered by the summary above.  Ericsson had concrete proposal for modification of objectives.  **Tentative agreements:**  None.  **Candidate options:**  Further discuss whether the following objectives, which are based on Ericsson proposal, are agreeable.  **Core part:**  The objectives of the core part are as follows:   * Introduction of NR band n1 and n3 to support high power UE (Power class 2) * Specify the following RF characteristics for n1 and n3~~, including~~:  1. Specify UE maximum output power, Tx power tolerance for band n1 and n3. 2. Specify A-MPR requirements for band n1 and n3 if needed 3. Specify PC2 MSD requirements for NR band n1. 4. Specify PC2 MSD requirements for NR band n3.  * Based on UE-implementation based solution, i.e., P-MPR solution, for SAR issue * Based on 2Tx architecture * Taking all the outcome from SI captured in TR 38.861 into account   **Perf. part**  Specify the necessary performance requirements such as release independence in TS 38.307.  **Recommendations for intermediate round:**  Further discuss the above proposed objectives. |
| **Sub-topic #2-3 Specs & timeline** | 5 companies commented. Apple, Mediatek, Samsung proposed to postpone WI to Rel-18.  **Tentative agreements:**  None.  **Candidate options:**  None.  **Recommendations for intermediate round:** |

## Intermediate round

### Comments & responses

Based on the initial round discussion, the key issue would be whether to approve a Rel-17 WI or Rel-18 WI. Some companies quested about the technical essence and merit of HPUE for FDD bands after the SI is closed.

**Sub-topic 2-1: Any question or comment on the justification or any other general comment for WI?**

Based on the discussions, the following alternatives are provided for further discussions:

* Alternative 1:
  + Approve a spectrum related WI for FDD PC2 high power UE in Rel-17
    - Covering NR band n1 and n3
    - Based on UE-implementation based solution, i.e., P-MPR solution, for SAR issue
    - Based on 2Tx architecture
    - Taking all the outcome from SI captured in TR 38.861 into account
  + Discuss the basket work item to cover other FDD PC2 bands in Rel-18
* Alternative 2:
  + Postpone the new WID for FDD PC2 high power UE to Rel-18

Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We are ok with Alt. 1 |
| OPPO | Slightly prefer Alt 2 considering the RAN4 work load and challenges in completing existing Rel-17 WIs, but Ok with Alt 1 if this is the majority view. |
| Apple | Alternative 2 is our preference  We understand that the SI has been closed. Unfortunately, in our view the SI was closed with many remaining open questions. For example, on the SAR issue, if the UE implementation-based method can always be used, then there is no need to discuss SAR issue at all at the very beginning. In our observation, after several rounds of discussions without conclusion, companies were simply tired and “UE-implementation-based method” or P-MPR was just an easy way out as they are less controversial. If we would always apply P-MPR which means it is not HPUE at all.  On the other hand, we also did not get an explanation why PC2 at 50% duty cycle would do better than PC3 at 100% duty cycle with 50% resource allocation. We certainly appreciate companies’ efforts on providing the system simulation results to demonstrate the performance gain. However, simulation platform is like a black box which is not easy to envision what is inside. We would feel more comfortable if an intuitive explanation on the performance gain can be provided.  Furthermore, we do not understand why half-duplex could not be considered. The reason why HPUE can be smoothly and successfully introduced for TDD bands is simply that they are operating in half-duplex mode where SAR issue can be managed and there is no REFSENS concern at all such that full UL allocation can be applied with a short UL burst. This is also how GSM operates where half-duplex in FDD bands can avoid UL impact to DL REFSENS when UL transmission is up to 33 dBm. |
| Xiaomi | Alt 1 can be acceptable for us |
| Telstra | Alt 1 is preferred |
| CMCC | We are OK with either Alt 1 or Alt 2 |
| vivo | From RAN4 workload perspective, we also prefer Alt 2, to give companies more meeting time to develop the corresponding requirements. |
| Telecom Italia | Alt. 1 – the proposal is to have a spectrum Work Item |
| LGE | LGE is fine to Alt.1. When RAN4 consider both 1Tx/2Tx RF architectures, then Alt.2 is also OK to us. |
| Huawei, HiSilicon | Alt 1 is preferred. According to the conclusion of the SI, the main work for the band specific requirements is to specify the MSD requirements. And there are not additional work for SAR solution, as P-MPR is the solution adopted in SI stage. |
| Samsung | Our preference is Alt 2 based on our previous comments. All the methods in the SI conclusion were the baseline solutions which actually do not need the additional discussions from the beginning. Large P-MPR based on UE implementation or large MSD might lead us to the additional discussion in the future. |
| ZTE | We support Alternative #1. |
| MediaTek | We share same view as vivo. We are okay to Alt 2 at this stage. |
| Skyworks | We support Alt 2. For Alt 1 we do not agree that 2Tx architecture is the baseline, 1Tx architecture are feasible and more generic, less architecture impact on the UE and lower MPR across all frequencies as we stated initial round. |
| Ericsson | We support alternative 1 except that 1TX should be the baseline for FDD bands, the 2TX architecture an optional architecture for FDD bands in the 2 GHz range. |
| China Unicom | We support Alternative 1.  For SAR solutions, RAN4 didn’t reach consensus in the SI stage except P-MPR. |
| Vodafone | We are ok with either alternative. It would be preferable to start the work sooner, but we appreciate with the scope and RAN4 workload this may not be feasible. |
| Orange | We support Alt1 |

**Sub-topic 2-2: Comments and responses on the proposed objectives**

Based on the outcome of sub-topic 2-2, if alternative 1 is agreeable, the following objectives can be further discussed.

**Core part:**

The objectives of the core part are as follows:

* Introduction of NR band n1 and n3 to support high power UE (Power class 2)
* Specify the following RF characteristics for n1 and n3~~, including~~:

1. Specify UE maximum output power, Tx power tolerance for band n1 and n3.
2. Specify A-MPR requirements for band n1 and n3 if needed
3. Specify PC2 MSD requirements for NR band n1.
4. Specify PC2 MSD requirements for NR band n3.

* Based on UE-implementation based solution, i.e., P-MPR solution, for SAR issue
* Based on 2Tx architecture
* Taking all the outcome from SI captured in TR 38.861 into account

**Perf. part**

Specify the necessary performance requirements such as release independence in TS 38.307.

Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Does MPR need to be studied also? We recognize that TxD MPR has already been agreed for PC2, however, that was in the context of TDD. For FDD the assumptions (esp. front-end loss would be higher for these bands) would be different so the conclusion might also be different. |
| T-Mobile USA | To Qualcomm: Doesn’t the same MPR always apply to all bands, whether FDD or TDD, and then A-MPR is allowed if additional MPR is needed? If needed, it might be a better idea to have generic A-MPR that applies to all FDD bands for PC2 rather than to re-think the baseline that MPR applies to all bands. |
| OPPO | Ok with objectives, also would like to understand better on whether MPR needs to be reviewed. Hope could get clarification. |
| SoftBank | Sorry to miss our comment in the initial round, but we would like to add a bullet (or note) in the scope to ensure the UE behaviour when the regulatory does not allow the use of PC2, which is quite important to us  "- Ensure that the UE RF requirements of power class 2 UEs shall comply with those of power class 3 when the maximum transmit power is limited to 23dBm by gNB configuration. |
| Apple | Though we mentioned 1Tx and 2Tx in first round discussions, we do have concern that 2Tx likely would not be the mainstream implementation for FDD bands as it requires two PAs and two duplexers. On the other hand, if P-MPR is the only solution, that means UE would mostly operate in PC3 domain where 2Tx would be a waste of hardware cost.  We would also like to include half-duplex mode into the objective where P-MPR would not be the only solution for SAR mitigation. |
| Xiaomi | Ok with objectives |
| CMCC | OK with the objectives |
| vivo | We also do not understand why the WI scope is limited to 2Tx architecture. In the SI conclusion, both 1Tx and 2Tx are agreed and captured, “In order to support 26dBm UE Tx power, two RF architectures (i.e. 2Tx×23dBm and 1Tx×26dBm) are considered and agreed during the study”. So the bullet should be updated to：   * Based on 1Tx and 2Tx architecture |
| Telecom Italia | Ok with objectives |
| LGE | LGE support these objectives in the new WID |
| Huawei, HiSilicon | OK with the objectives |
| Samsung | At least, the last bullet can be removed for the possible enhancement in the WI phase, if any. We only have the baseline method during the SI due to the lack of consensus. Otherwise, it can be discussed in the later release with better consensus on the assumptions. |
| ZTE | We are fine with the modified objectives shown. |
| MediaTek | We are okay to Apple and VIVO’s suggestion about RF FE architecture.  Moreover, with further beneficial reasons below, we suggest to update the bullet to   * Based on 1Tx, 2Tx, H-Duplex architecture   Regarding objective of bands, we think n1 and n3 are mid-bands, to update clear wording below   * Introduction of NR mid-bands n1 and n3 to support high power UE (Power class 2)   From RAN-P colleagues’ opinions, we can fully understand intention of enabling low-bands n5/n28 in future. We are not against it and are open for discussion of low bands in Rel-18.  Reasons about benefits of including H-Duplex mode:   * Regarding having FDD bands running at half-duplex mode when UE UL power above Power threshold of [23dBm] and full-duplex mode when UL power<=23dbm, it could enable a quickly feasible adoption for HPUE in NR FDD mid-bands without ultra-high MSD in RX * Restricting UL wide BW to 20MHz for FDD PC3 still need high MSD * Power threshold to enable HD mode could be configured by gNB or UE for flexibility * Implementation of RF FE architecture for HPUE in NR FDD mid-bands   + 1TX: 1PA + 1 duplexer   + 2TX: 2PA + 2 duplexer   + H-Duplex : 1PA + 1 duplexer + 1 SAW * Having optional half-duplex mode may provide flexibility for enabling HPUE in NR FDD low-bands if needed. |
| Skyworks | We do not agree with 2Tx only and actually 1Tx should be the baseline as it can apply across all frequency ranges, has lower MPR and lowest RFFE architecture impact. Note that the data provided on MSD for the SI is based on 1Tx. Furthermore for the SAR mitigation, for the solution to be applicable in a generic way we do not understand why it should be limited to PMPR |
| Ericsson | Objectives look fine except the 2TX baseline architecture. 1TX should be the baseline for FDD bands, the 2TX architecture an optional architecture for bands in the 2GHz range. |
| China Unicom | We are fine with the revised objectives from moderator.  From our understanding, MPR is a generic requirement for all bands, and A-MPR requirements can be specified for specific bands, if needed.  For UE architecture, we would like to make the following quotations from the TR “*It is found out that FDD HPUE with 2Tx architecture is feasible and can reuse existing RF components targeted for PC3, while 1Tx may need to use newly designed components. So further analyses of 1Tx architecture could be carried out when the new components become available.*” So this WID is based on 2Tx architecture. |
| Orange | We are ok with the objectives |

### Summary

Moderator summarizes discussion status for this round, list all the identified open issues and tentative agreements or candidate options and suggestion for next round.

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic 2-1 and Sub-topic 2-2** | **Topic #2: HPUE PC2 for NR FDD band**  The situation is as below:   * Alternative 1: Approve a spectrum related WI for FDD PC2 high power UE in Rel-17 …(Qualcomm, Xiaomi, Telstra, Telecom Italia, Huawei, HiSilicon, ZTE, Ericsson, China Unicom, Orange) * Alternative 2: Postpone the new WID for FDD PC2 high power UE to Rel-18 (Apple, Vivo, Samsung, Mediatek. Skyworks) * Either Alternative 1 or Alternative 2 (OPPO, CMCC, LGE, Vodafone)   Moderator would like to provide a compromise solution based on Alternative 1 capturing companies’ comments.   * **Proposal #2**: Endorse the Alternative 3 for HPUE PC2 for NR FDD band   + Alternative 3:     - Approve a spectrum related WI for FDD PC2 high power UE in Rel-17       * Covering NR band n1 and n3       * Using UE-implementation based solution, i.e., P-MPR solution, as baseline for SAR issue, and have further discussion on other SAR solutions, which was not discussed in SI, if agreeable.       * Further evaluate the impact of PC2 on MSD when specifying the MSD requirements       * Based on 2Tx architecture       * Taking all the outcome from SI captured in TR 38.861 into account     - Discuss the basket work item to cover other FDD PC2 bands in Rel-18   **GTW discussion on Wednesday:**  Skyworks and Ericsson proposed to add 1Tx as baseline. So we can further discuss that part in final round. |

## Final round

### Comments & responses

Based on the comments and GTW discussion, the following modified proposal #2 can be further discussed in final round.

* **Modified Proposal #2**: Endorse the Alternative 3 for HPUE PC2 for NR FDD band
  + Alternative 3:
    - Approve a spectrum related WI for FDD PC2 high power UE in Rel-17
      * Covering NR band n1 and n3
      * Using UE-implementation based solution, i.e., P-MPR solution, as baseline for SAR issue, and have further discussion on other SAR solutions, which was not discussed in SI, if agreeable.
      * Further evaluate the impact of PC2 on MSD when specifying the MSD requirements
      * Based on 2Tx and 1Tx architecture
      * Taking all the outcome from SI captured in TR 38.861 into account
    - Discuss the basket work item to cover other FDD PC2 bands in Rel-18
    - NOTE: Ensure that the UE RF requirements of power class 2 UEs shall comply with those of power class 3 when the maximum transmit power is limited to 23dBm by gNB configuration.

(Moderator: to Mediatek, this WI is for FDD. Why do we need consider HD-FDD? And regarding “Based on 1Tx, 2Tx, H-Duplex architecture”, it seems that 1Tx, 2Tx and H-Duplex do not belong to same category. H-Duplex seems a solution to handle the interference. Should we include it in MSD part?)

**Question: Can we agree on modified proposal #2? If not, how can we modify it to move forward.**

Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| T-Mobile USA | We prefer that this be an Rel-18 WI. Given the need to prioritize, we think that improved MSD is a higher priority for Rel-17. |
| Qualcomm | One of the concerns raised during the course of the SI is that there aren’t PC2 components for FDD readily available for 1Tx architecture. If we include 1Tx into the WI, I’m not sure we will have reliable data from multiple sources to derive the requirements. |
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### Summary

Moderator summarizes discussion status and provide the recommendation.

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #2-X XXX** | Recommendations: |
|  |  |
|  |  |

# Topic #3: Increasing UE power high limit for CA and DC

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Title** | **Sourcing company** |
| [RP‑212163](file:///C:\Users\d00375225\AppData\Local\Temp\Rar$EXa6264.33390\docs\RP-212163.zip) | New WID: Increasing UE power high limit for CA and DC | China Telecom |
| [RP‑212364](file:///C:\Users\d00375225\AppData\Local\Temp\Rar$EXa6264.33390\docs\RP-212364.zip) | Way forward on "Improved MSD" and "Lifting the restriction on MOP imposed by PC" | Nokia, Nokia Shanghai Bell |

## Initial round

### Comments & responses

**Background information:**

This issue was discussed in RAN4 #100e in agenda for WI NR\_PC2\_SUL\_CA. There was no consensus how to treat this topic since there is no corresponding objective in WI NR\_PC2\_SUL\_CA. The corresponding discussions in RAN4 were summarized in R4-2115021.

Besides, in Rel-18 uplink enhancement discussion, one topic about “power aggregation” was also under discussion.

In this section, we collect the comments and responses for the proposed work item. Based on the comments, we will decide how to move forward in the next step.

**Sub-topic 3-1: General comments on how to organize the work and in which release the work can be done?**

In RP-212163, the proponents proposed to start the work in Rel-17 to increase the maximum output power limitation for dual PA equipped UE for CA and DC.

In RP-212364, the proponents proposed

* ***Way forward to “Lifting the restriction on MOP limited by the power class”***
  + ***RAN tasks RAN4 to establish objectives for SI or WI where the objective shall be ones to study if the new method, i.e., Option 2 in [3] can achieve similar outcomes as conventional power class method can.***
  + ***This topic is handled under a dedicated SI or WI in Rel-17 or 18 based on the objectives.***

Companies are invited to provide the general comments, including comments on justification part, whether the WI is needed, how to handle the work, in the follow table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Xiaomi | This issue has been discussed for several RAN4 meetings but no consuses. Several open issues have been identified. We support to have a dedicated SI for this issue. Considering the current workload in RAN4, as a R18 item is our preference. |
| Verizon | RAN4 should initiative this work in Rel-17. |
| Qualcomm | We agree that having two dedicated WI for increasing MOP is sensible (see RP-212163). This should be Rel-17. Since the work has already been ongoing, introducing this new work item does not increase the workload for RAN4. However, deferring to Rel-18 would create a discontinuty in the ongoing work for 6-9 months, maybe even longer depending when Rel-18 can start. |
| OPPO | We support the efforts in best use of UE power ability, and can be further discussed how to make it possible. Regarding the work handling, our suggestion is Rel-18 since currently the most challenging problem for RAN4 is to complete all work items in Rel-17. Whether dedicated SI/WI can be further discussed. |
| T-Mobile USA | Since discussions have already been ongoing in RAN4 we support continuing with a WI in Rel-17 rather than delaying until Rel-18. |
| China Telecom | We agree with the previous comments that this work has already been discussed in RAN4 for several meetings, with only two options left for further down-selection. It seems not good to drop it from Rel-17. Formulating the work in a dedicated WI is beneficial from the perspectives of better organizing and tracking of the discussion, but not increases the workload. |
| LGE | We prefer to study the open issues in SI in Rel-18 as mentioned from Xiaomi and OPPO. |
| CMCC | As pointed by some companies, this issue had been discussed for several meetings but no consensus. Not sure the work can be easily completed in Rel-17 timeline. Better to consider as a Rel-18 WI. |
| Apple | We share the similar view as Xiaomi. A dedicated SI in Rel-18 would be our preference to better manage Rel-17 workload in RAN4. |
| vivo | We support to do some study, Rel-18 would be a better timeline to perform some comprehensive study and do analysis on potential RF requirements impacts. |
| Intel | This work item can be classified as a non-spectrum item and aims to introduce generic enhancement rather than specific improvement for a certain band. RAN4 is already overloaded, and we do not see opportunity to do the work within Rel-17 timeframe. A new SI/WI shall be discussed as a part of Rel-18 package. |
| Telecom Italia | Support as a Rel 17 Work Item |
| Vodafone | As per other operator comments, we support continuing with a Rel-17 WI |
| Nokia | Our view is similar to what Qualcomm mentioned. |
| ZTE | We support this work is done in Rel-17, and a WI for this would be preferred in order to correctly reflect RAN4’s ongoing activities in RAN4 TU budget table. |
| AT&T | We also support this work in Rel-17. |
| Huawei, HiSilicon | As mentioned in the background info, the topic has been discussed for a bit long time even it is not in the WI scope. We think that this kind of discussion without objectives in any WIs should not be encouraged in RAN4 as the workload is extremely high already. Considering that RAN4 already agreed two options for the topic, that could be considered as starting point to have further study in Rel-18. |
| MediaTek | We can understand Xiaomi and OPPO’s suggestion. And if there is no room for solving the controversies and reaching consensus at this stage, we are okay to manage the issues in dedicated SI in Rel-18. |
| Ericsson | We also support dedicated WI for this issue in R17. |
| Skyworks | There are open points on how this should be enabled (power class/ vs power boosting vs sum of per band power class) and the implication on duty cycle reporting that are not addressed here |
| China Telecom 2 | We’d like to response the comment on spectrum or non-spectrum item: To our understanding, several HPUE (PC2 or PC1.5, single band or dual band CA/DC,…) and bandwidth (irregular CBW, 35/45MHz CBW) related SI/WIs were approved as spectrum WIs, and this UE maximum power WI just falls into the same category.  We understand that in the Rel-18 discussion, there are some discussion on the new boundary between spectrum and non-spectrum. But if any new agreement on the boundary will be agreed, it applies to Rel-18 and not impact Rel-17. |

**Sub-topic 3-2: Comments and responses on objectives for WI proposed in RP 212163**

**Core part**

The objectives of the core part are as follows:

1. Consider the two options and study the feasibility and impacts for option 1.
   * Option 1: Improvement on power high limit
   * Option 2: Definition of a new power class for CA and DC
2. If the consensus for 1) is option 1, then specify higher maximum output power for dual PA equipped UE’s for CA and DC
   * Replace the power class with sum or modified sum in PCMAX\_H in CA/DC
   * All associated core requirements are also to be specified
   * SAR mechanisms are modified, if needed, to allow for higher transmit power
   * Example combination as CA\_n1A-n78A (23dBm+26dBm) is considered when specifying the band-combination specific core requirements.

**Perf. part:** N/A

Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Xiaomi | We are ok with the objectives. |
| Verizon | We support Option 1, and this has considered the significate new possible validations from Option 2.  As this work is to increasing the UE power limit for CA and DC, we believe the scope of this work should cover all of the possible UE power limits defined by RAN4, including PC5, as a package of RAN4 work |
| OPPO | We are open for the work contents of improving UE max power capability, however, as commented above, our view is this work should be discussed in Rel-18 considering the challenges of completing all Rel-17 WIs in RAN4.  Sometimes we see the statement of “not much work of introducing this WI thus can be accommodated in certain release”, however, we would like to point out that it is true for certain companies with many delegates and resources but for others this apparently is not the case. |
| T-Mobile USA | We support the objectives |
| China Telecom | We support the objectives |
| LGE | The Objective are fine for SI in Rel-18. |
| CMCC | We wonder whether this is a spectrum WI or not, since some general requirements that not band specific will be impacted, e.g. PCMAX\_H |
| Apple | Since either Option 1 or Option 2 has its own drawback which is still tied to the conventional power class definition for CA, other options such as per-band based UL requirements as in FR1+FR2 should not be precluded. |
| vivo | We share similar view with CMCC, this rel-18 SI should be a non-spectrum proposal, which is general solution for all CA/DC. |
| Intel | Same comments as for issue 3-1 |
| Vodafone | We support the objectives. |
| Nokia | We believe the proposed objectives need to be modified in a more appropriate manner. That is the reason we submitted a paper of RP 212364. For example, it is difficult to understand what exactly “Option 1: Improvement on power high limit” means. As we commented in our paper, the original purpose of the idea is if there is a way to specify requirements to allow UE to transmit the sum of the individual rated PA power classes by lifting the restriction from the Power Class for UL inter band CA or DC. The focus of the “Study” is if PPowerClass,CA is replaced with 10log10∑ pPowerClass,c is feasible or not. If we go with new power classes, study of the “way” to use additional power class is not needed, since we just introduce new power classes with necessary requirements, though technical analysis to derive MSD etc is needed but this is irrelevant to the new method or new power class. |
| ZTE | We support the objectives. |
| AT&T | We support the proposed objectives of the WI. |
| Huawei, HiSilicon | The two options agreed in RAN4 are treated equally during the discussion. As commented in sub-topic 3-1, we think this should be a Rel-18 study. During the further release study, firstly, to further down select the option. Secondly, to specify the corresponding requirements for the selected option. It seems the current objectives favor option 1, we think it may not be appropriate to have such pre-condition for further study. |
| MediaTek | We can understand the intention of option1 and option2. There are still several issues which need further discussion for option1 and option 2, to have more discussion for colleagues is better. |
| Ericsson | Objectives look fine to us. |
| Skyworks | We believe the sum of per band power class high level is the right approach and clarification on impact of duty cycle reporting should be addressed. In the objective it should be clear that only inter-band CA/DC is targeted. Also this should be an optional capability (similar to power boosting) |

**Sub-topic 3-3: Comments and responses on impacted/new specifications and target completion date**

The proposed impacted specifications as well as target completion date are as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **Impacted existing TS/TR** *{One line per specification. Create/delete lines as needed}* | | | |
| TS/TR No. | Description of change | Target completion plenary# | Remarks |
| 38.101-1 | Introduce improvement for power high limit for CA to the spec of NR User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone | RAN#95e | Core part |

Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| Apple | A commented earlier, our preference is to have an SI no earlier than Rel-18. |
| Huawei, HiSilicon | See comments for 3-1 and 3-2, we think detailed info can be discussed in Rel-18. |
| Ericsson | The spec TS 38.306 and TS 38.331 must be modified should option 1 in the WID be adopted (new capability added and the default BC power-class reporting must be modified if this capability is present). |
|  |  |
|  |  |

### Summary

Moderator summarizes discussion status for this round, list all the identified open issues and tentative agreements or candidate options and suggestion for next round.

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #3-1 General** | 20 companies commented.  The content of WI is based on RAN4 discussion. There is no much comment on motivation and justification. The key issue is how to manage the work.  **Rel-17 or Rel-18:** The key issue is how to manage the work, i.e., whether to have a dedicated study in Rel-18 or have a WI in Rel-17. There are two camps.  **Spectrum related vs non-spectrum related**: Intel, CMCC, Vivo commented that the proposed WID is non-spectrum related since the general solution which is not band specific needs be specified, which China Telecom responded that *To our understanding, several HPUE (PC2 or PC1.5, single band or dual band CA/DC,…) and bandwidth (irregular CBW, 35/45MHz CBW) related SI/WIs were approved as spectrum WIs, and this UE maximum power WI just falls into the same category*.  Besides, company pointed out that *this kind of discussion without objectives in any WIs should not be encouraged in RAN4 as the workload is extremely high already* and according to RAN4 agreement.  **Regarding two options,** Skyworks pointed out some open issues which need further discussion. Huawei commented that according to RAN4 agreement both options should be treated equally as the starting point. Apple though both options have drawback and need more discussions. Nokia commented that some clarifications on option 1 and 2 are needed. Mediatek commented that there are still several issues which need be discussed for both options.  **Tentative agreements:**  None.  **Candidate options:**   * Alternative 1: Approve a Rel-17 WI for increasing UE power high limit for CA and DC (Verizon, Qualcomm, T-Mobile, China Telecom, Telecom Italia, Vodafone, Nokia, ZTE, AT&T, Ericsson) * Alternative 2: Discuss and strive to approve the new item for study of increasing UE power high limit for CA and DC in Rel-18 (OPPO, LGE, CMCC, Apple, VIVO, Intel, Huawei, Mediatek, Xiaomi)   **Recommendations for intermediate round:**  Further discuss the above two alternatives and seek for the compromised solution. |
| **Sub-topic #3-2 Objectives** | 18 companies commented.  9 companies seemed OK with the objective. 9 companies prefer to have study in Rel-18.  Huawei commented that the current objective favor option1 and both options should be treated equally according to RAN4 agreement. Verizon proposed to also include PC5. Apple commented that both options have drawbacks. Nokia commented that clarification about objectives to be studied is needed. Mediatek thought that *there are still several issues which need further discussion for option1 and option 2*. Skyworks commented sum of per band power class is right approach and clarification on impact of duty cycle reporting should be addressed. And it should be clarified that only inter-band CA/DC is targeted.  **Tentative agreements:**  None.  **Candidate options:**  **Core part**  The objectives of the core part are as follows:   1. Consider the two options and study the feasibility and impacts for option 1.    * Option 1: Improvement on power high limit      + Specify requirements to allow UE to transmit the sum of the individual rated PA power classes by lifting the restriction from the Power Class for UL inter band CA or DC.      + Study if PPowerClass,CA is replaced with 10log10∑ pPowerClass,c is feasible or not.      + Clarification on impact of duty cycle reporting should be addressed    * Option 2: Definition of a new power class for CA and DC      + Introduce new power classes with necessary requirements 2. If the consensus for 1) is option 1, then specify higher maximum output power for dual PA equipped UE’s for CA and DC    * Replace the power class with sum or modified sum in PCMAX\_H in CA/DC    * All associated core requirements are also to be specified    * SAR mechanisms are modified, if needed, to allow for higher transmit power    * Example combination as CA\_n1A-n78A (23dBm+26dBm) is considered when specifying the band-combination specific core requirements. 3. The target scenario is inter-band CA or DC 4. Both solutions of Option 1 and Option 2 are optional   **Perf. part:** N/A  **Recommendations for intermediate round:**  Further discuss the above objectives if Alternative 1 is agreeable. |
| **Sub-topic #3-3 Specs & timeline** | 3 companies commented.  Ericsson commented that TS 38.306 and TS 38.331 should be included if option 1 is adopted.  **Tentative agreements:**  None.  **Candidate options:**  None.  **Recommendations for intermediate round:**  Comment above may need be taken into account. |

## Intermediate round

### Comments & responses

**Sub-topic 3-1: General comments on how to organize the work and in which release the work can be done?**

Based on the initial round discussion, the following alternative solutions need be further discussed:

* Alternative 1: Approve a Rel-17 WI for increasing UE power high limit for CA and DC (Verizon, Qualcomm, T-Mobile, China Telecom, Telecom Italia, Vodafone, Nokia, ZTE, AT&T, Ericsson)
* Alternative 2: Discuss and strive to approve the new item for study of increasing UE power high limit for CA and DC in Rel-18 (OPPO, LGE, CMCC, Apple, VIVO, Intel, Huawei, Mediatek, Xiaomi)

Based on above two alternative, the compromised solution are welcome.

Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| AT&T | We continue to support Alternative 1. However, in the interest of a compromise solution, we could also support a study item in Rel-17 timeframe with a Rel-18 WI based on the outcome of the study. We would prefer not to start the study in Rel-18 as proposed by Alternative 2 and have the study outcome available prior to Rel-18. |
| Qualcomm | We support alternative 1. As the moderator stated, there is no question about the motivation or justification for this work, but only about work handling. As we and others commented in the initial round, this work has already been ongoing for the past several meetings in RAN4 so starting this WID now does not increase the workload. However, we also see that there is a separate proposal on “low MSD” that also has the same consideration about starting in Rel-17 or waiting until Rel-18. Since this work item on increasing MOP has a WID presented already at this RAN plenary meeting, we suggest a compromise could be to agree to this WID now and defer the low MSD to Rel-18 to help balance the workload. |
| T-Mobile USA | We support alternative 1. |
| OPPO | Alt 2. As commented above, our view is this work should be discussed in Rel-18 considering the challenges of completing all Rel-17 WIs in RAN4. Therefore, we **have concern** of introducing the WIs/SIs in Rel-17 from workload perspective. Continuing adding load to RAN4 in the late Rel-17 is not encouraged. |
| China Telecom | We support alternative 1.  We agree with moderator’s initial round summary that the motivation and justification for this work is clear.  Also, as companies commented in the initial round, the higher uplink output power is already supported for some existing UE implementations, e.g., 23dBm+26dBm PA supported for inter-band CA/DC, we just need to complete the 3GPP requirements to better utilize the UE ability. |
| Apple | Alternative 2 is our preference. |
| Verizon | We support Alternative 1!  This WID should be in Rel-17. As compromise, we are fine to defer the low MSD to Rel-18 to balance the RAN4 workload. |
| Xiaomi | Alt 2 is our preference. However, we can also accept the suggestion from Qualcomm that to balance the workload, agree this WID as R17 and defer the low MSD to Rel-18. |
| Intel | Prefer Alternative 2. First of all, we consider this is as a non-spectrum WI. Rel-17 RAN4 RF TU capacity is already full till the end of Release 17. Approval of additional WI close to the completion of Rel-17 will have negative impact on the progress for the remaining projects. We prefer to discuss the potential objectives as a part of Rel-18 email discussion. Also, we think that wording of Alt 2 shall be adjusted and whether to approve the Rel-18 WI should be decided based on level of support among different proposals and it is out of scope of current discussion. |
| CMCC | We prefer Alt. 2. In email thread 02, companies are still discussing the balance between adding WG meetings and the heavy workload for delegates. From our view, it is not appropriate to approve new Rel-17 WIs at the very end of the release. Also, as we commented in 1st round, we think this WI belongs to non-spectrum since it will impact the general requirements not only band specific requirements. |
| vivo | Prefer Alt 2. |
| Telecom Italia | Alt. 1. This is a spectrum activity |
| LGE | LGE support Alt. 2. This issue can be treated as a dedicated new SI/WI in Rel-18. We think it is not the scope of the spectrum-related. We are OK with QC proposal as a compromised solution. But it has still a problem with the TU budget. |
| Huawei, HiSilicon | We support Alt 2. The requirements are not band specific, which are non-spectrum generic requirement. According to the previous RAN discussion, new non-spectrum related WI/SI should not be further considered in Rel-17. We disagree with the comments that since the issue has been discussed for several RAN4 meetings, it does not increase the RAN4 workload. Actually, RAN4 suffered great for this kind of discussion which is not included in any WI scope. In addition, we noticed that there are some related discussion on power enhancement for Rel-18 in other WGs, that aspect should also considered. For Rel-18, whether dedicated SI/WI is beyond the discussion for the Rel-17 issue, which can be further discussed along with other Rel-18 topics. |
| ZTE | We support Alternative #1. The works have been carried out and two options are down-selected. Approving the WI is a good way to go and saves RAN4’s efforts already spent. As other companies, the compromise of deferring the low MSD works to Rel-18 is ok to us for the sake of balancing the RAN4 workload. |
| MediaTek | We think open issues and controversies can be indeed solved according to Alt 2. We are fine to Alt 2. |
| Skyworks | This is definitively a non-spectrum item as this would apply generically to all band combinations. Given the current RAN4 load we prefer Alt2 |
| Ericsson | We support alternative 1. |
| Nokia | Alternative 1 is the most efficient way since if we discuss this in Rel-18, the discussion starts from Q3 2022 and we would like to re-emphasize that the discussion has been discussed in RAN4 thus far. Hence, the work should not be counted as additional one, even if a new Rel-17 SI or WI for this topic is approved.  Nonetheless, if approving several new WIs/SIs for Rel-17 now impacted on the number of future RAN4 meetings, the WIs/SIs should be handled not to increase the number of the meetings further, e.g., the number of the WIs or SIs is limited or the scope is down-selected etc., considering the whole RAN4 workload. |
| Vodafone | We support alternative 1. |
| Orange | We support Alt1 |

**Sub-topic 3-2: Comments and responses on objectives for WI proposed in RP 212163**

If Alternative 1 is agreeable, then encourage companies have further discussion on the objectives below.

**Core part**

The objectives of the core part are as follows:

1. Consider the two options and study the feasibility and impacts for option 1.
   * Option 1: Improvement on power high limit
     + Specify requirements to allow UE to transmit the sum of the individual rated PA power classes by lifting the restriction from the Power Class for UL inter band CA or DC.
     + Study if PPowerClass,CA is replaced with 10log10∑ pPowerClass,c is feasible or not.
     + Clarification on impact of duty cycle reporting should be addressed
   * Option 2: Definition of a new power class for CA and DC
     + Introduce new power classes with necessary requirements
2. If the consensus for 1) is option 1, then specify higher maximum output power for dual PA equipped UE’s for CA and DC
   * Replace the power class with sum or modified sum in PCMAX\_H in CA/DC
   * All associated core requirements are also to be specified
   * SAR mechanisms are modified, if needed, to allow for higher transmit power
   * Example combination as CA\_n1A-n78A (23dBm+26dBm) is considered when specifying the band-combination specific core requirements.
3. The target scenario is inter-band CA or DC
4. Both solutions of Option 1 and Option 2 are optional

**Perf. part:** N/A

Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| AT&T | We think that the second bullet added under Objective 1 Option 1 is similar to the first bullet under Objective 2 but they don’t present the same options. The study should include the same set of summation options.  We don’t agree with the addition of Objective 4. The decision on optional or not should be made after the study.  In line with our comments on Sub-topic #3-1, we could consider modifying the objectives to be Rel-17 study item objectives. |
| OPPO | It premature to further discuss and agree on the WI/SI scope, and our suggestion is to move this discussion to Rel-18 as the proposals there already starts. And suggest proponents to propose this topic there for a thorough discussion with other proposals.  And the option 1 and 2 can be considered as the starting point but not the only two choice, other options can be considered in Rel-18 WI since neither of these two options seems perfect as pointed out by other companies in 1st round. |
| China Telecom | Some suggested updates on the objectives (highlighted by yellow below):  For bullet 4), as E/// commented, 38.306 and 38.331 will be added in the impacted specs, so this bullet is not needed.   1. Consider the two options and study the feasibility and impacts for option 1.    * Option 1: Improvement on power high limit      + Specify requirements to allow UE to transmit the sum of the individual rated PA power classes by lifting the restriction from the Power Class for UL inter band CA or DC.      + Study if PPowerClass,CA is replaced with 10log10∑ pPowerClass,c is feasible or not.      + Clarification on impact of duty cycle reporting should be addressed, if duty cycle reporting based SAR solution is considered.    * Option 2: Definition of a new power class for CA and DC      + Introduce new power classes with necessary requirements 2. If the consensus for 1) is option 1, then specify higher maximum output power for dual PA equipped UE’s for CA and DC    * Replace the power class with sum or modified sum in PCMAX\_H in CA/DC    * All associated core requirements are also to be specified    * SAR mechanisms are modified, if needed, to allow for higher transmit power    * Example combination as CA\_n1A-n78A (23dBm+26dBm) is considered when specifying the band-combination specific core requirements. 3. The target scenario is inter-band CA and DC 4. ~~Both solutions of Option 1 and Option 2 are optional~~ |
| Apple | We would like to propose an “Option 3” which is a mixture of “Option 1” and “Option 2”, meaning that only to define a single conceptual power class where the total power upper limit is 10log10∑ pPowerClass,c  We can further discuss whether a new PCMAX equation is needed for the new power class in consideration whether PCMAX, CA would ever be needed.  The SAR mitigation and how to handle MSD requirements for various power combinations also need to be included in the objectives. |
| Verizon | We agree with AT&T comment above!  For the updated objectives above, we should keep the original third bullet under Option 1, and don’t believe it is necessary for the new added “if duty cycle reporting based SAR solution is considered” in this bullet. |
| Intel | It is premature to discuss objectives unless an agreement whether to introduce a new item is reached. |
| CMCC | The current objectives cover also general requirements, not only band specific requirements, should not be a spectrum WI. |
| vivo | As we commented before, we think this is a non-spectrum proposal, although the topic was raised from spectrum WIs. |
| Telecom Italia | We think the study phase could be avoided (work already ongoing in RAN4) |
| Huawei, HiSilicon | It’s premature to discuss the objectives for the moment. We think that is part of the discussion for Rel-18 topics. |
| Nokia | Again, we are not saying that option 1 should be prioritized. There is not that much to study something new for the option 2 compared to the option 1 as SI since the option 2 is defining new power classes. Actual requirements like MSD, or handling UL duty cycle are common to both options, but not need them for Study pahse. The option 1, however, requires some additional consideration since they don’t have a specific power class while e.g., requirements like MSD are normally handled after PC and associated channel bandwidths are clarified by request. Thus, we may need to discuss a kind of procedure on how appropriately needed MSD in a timely manner if the option 1 is used. The option 1 also requires some consideration on UL Duty cycle capability handling since that has been basically associated with a PC for a given band configuration. Now the PC is not signalled with the option 1. These delta between option 1 and 2 needs to be discussed, that what we meant.  We are afraid but we think more clarification is required for the current objectives due to the above reasons. We are aiming at allowing UEs with inherently hardware ability to transmit somewhere between the currently specified power classes. And we have two options. One of the new and the other is existing one. Given that a WI is proposed, the alternative is as follows.   * Study phase: Study methods to make UEs with hardware ability to transmit between the currently specified power classes. The assumption of the UEs are implementing 23dBm + 26 dBm.   + Compare the below two options to identity pros and cons of these options and study the feasibility of the option 1 in terms of at least SAR and MSD for CA and DC. Note that other aspects to be studied are not precluded.   + Option 1: No explicit power class signalling     - Allow UE to transmit the sum of the individual rated PA power classes by lifting the restriction from the Power Class for UL inter band CA or DC, i.e., PPowerClass,CA is replaced with 10\*log10∑ pPowerClass,c.   + Option 2: define a new power class for CA and DC * WI phase: Specify necessary requirements by the option 1 or 2 based on the outcome of the study.   + An example band configuration is CA\_n1A-n78A (23dBm+26dBm) and targets at transmitting up to 27.8 dBm.   + SAR mechanisms, MSD and others if any |
| ZTE | Fine with China Telecom’s revised objectives, except bullet 3). The current wording might lead to some mis-understanding: the target scenario (only one) is that both inter-band CA and inter-band DC should be configured. So it could be change to:  3) Target scenarios are inter-band CA and inter-band DC. |
| MediaTek | Due to no good solutions now, there are at least 3 options proposed now for debating. We share same view as OPPO and Huawei. |
| Skyworks | Regarding Nokia’s input we do agree that the MSD/SAR and target power are the same for both options. Regarding how to distinguish in option 1, we assume that since legacy UEs cannot support this that a capability is created thus it should be feasible to have dedicated MSD linked to this capability. Thus our preference is still option 1. |
| Ericsson | The objectives are acceptable: for Option 1 add a bullet on  “*Impact of band-combination capability indication and signaling*” (liaising with RAN2 as appropriate) |
| Orange | We are also fine with China telecom revisions, and agree that the study phase can be avoided as proposed by Telecom Italia |

### Summary

Moderator summarizes discussion status for this round, list all the identified open issues and tentative agreements or candidate options and suggestion for next round.

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|  | **Status summary** |
| **Sub-topic 3-1: General** | **Topic #3: Increasing UE power high limit for CA and DC**  Most of companies did not change their views. The situation of discussion is as follows:   * Alternative 1: Approve a Rel-17 WI for increasing UE power high limit for CA and DC (Verizon, Qualcomm, T-Mobile, China Telecom, Telecom Italia, Vodafone, Nokia, ZTE, AT&T, Ericsson, Nokia, Orange) * Alternative 2: Discuss and strive to approve the new item for study of increasing UE power high limit for CA and DC in Rel-18 (OPPO, LGE, CMCC, Apple, VIVO, Intel, Huawei, Mediatek, Xiaomi, Skyworks)   AT&T and Qualcomm provided compromise solutions. And Apple and Mediatek proposed Option 3 which is the mixture of Option1and Option 2. Based on them and considering balancing the workload in RAN4 as proposed by Qualcomm, moderator would like to propose to agree on the following alternative:   * **Proposal #3:** Endorse the Alternative 3 for increasing UE power high limit for inter-band CA and DC   + Alternative 3: Endorse the following proposals as a package considering balancing RAN4 workload     - Approve a Rel-17 SI to down-select the option between Option 1, Option 2 and other options (if any), and discuss and strive to approve objectives in Rel-18 WI/SI for increasing UE power high limit for inter-band CA and DC.     - Defer “low MSD” to Rel-18 new SI/WI package discussion.   NOTE: Option 1 and Option 2 for reference based on Nokia and China Telecom comments in intermediate round   1. Consider the two options and study the feasibility and impacts for option 1.    * Option 1: No explicit power class signalling      + Allow UE to transmit the sum of the individual rated PA power classes by lifting the restriction from the Power Class for UL inter band CA or DC, i.e., PPowerClass,CA is replaced with 10\*log10∑pPowerClass,c.      + Clarification on impact of duty cycle reporting should be addressed.    * Option 2: define a new power class for CA and DC      + Introduce new power classes with necessary requirements   **GTW discussion on Wednesday:**  Some companies still had concern on the proposal. Operators supported to start the work. |

## Final round

### Comments & responses

Keep Alternative 3 together with Alternative 1 and 2 and encourage companies to **provide constructive suggestions** on how to modify the alternative solutions and move forward.

* Alternative 1: Approve a Rel-17 WI for increasing UE power high limit for CA and DC (Verizon, Qualcomm, T-Mobile, China Telecom, Telecom Italia, Vodafone, Nokia, ZTE, AT&T, Ericsson, Nokia, Orange)
* Alternative 2: Discuss and strive to approve the new item for study of increasing UE power high limit for CA and DC in Rel-18 (OPPO, LGE, CMCC, Apple, VIVO, Intel, Huawei, Mediatek, Xiaomi, Skyworks)
* Alternative 3: Endorse the following proposals as a package considering balancing RAN4 workload
  + Approve a Rel-17 SI to down-select the option between Option 1, Option 2 and other options (if any), and discuss and strive to approve objectives in Rel-18 WI/SI for increasing UE power high limit for inter-band CA and DC.
  + Defer “low MSD” to Rel-18 new SI/WI package discussion.

Based on the conclusions, we can modified proposal 3 for endorsement.

**Questions: Can we agree on any alternatives?**

Companies are invited to provide comments and responses in the following table.

|  |  |
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| **Company** | **Comments** |
| Verizon | Again, we would repeat that we support the Alternative 1 and suggest approving a Rel-17 WI for increasing UE power high limits for CA and DC!    Although both MOP and lower MSD are more useful features for enhancement of network, we have compromised and agreed to initialize only one WI during the initial and intermediate rounds’ discussions for helping balance the RAN4 workload. This has considered both of items have already been a part of ongoing RAN4 discussions in past meetings, and the MOP proposal is a majority operators’ common request. |
| T-Mobile USA | Alternative 2. Given there is a need to prioritize Rel-17 work, we believe the low MSD work is higher priority |
| AT&T | Alternative 1 or our recommended Alternative 4 below.  We think that the feasibility study on “low MSD” in Rel-17 timeframe was already confirmed by RAN at RAN#92e based on wide operator support and RAN4 was tasked accordingly. The only addition at this meeting was to formalize the request into a SI since RAN4 was not able to come back to RAN in RAN#93e with any outcome due to the different views in RAN4 as to the extent of the objectives. We do not see why the “low MSD” feasibility study should be delayed to Rel-18 due to being considered as a package with UE higher power limit.  We could consider an Alternative 4 which is a Rel-17 SI for both UE higher power limit and “low MSD” to avoid the additional work associated with setting core requirements as part of the WI phase for UE higher power limit which will only further stress the MSD situation without some way forward. |
| Qualcomm | We prefer alternative 1. Alternative 3 proposes to downgrade the WI to a SI, but we don’t understand the need to do that since considerable discussion has already occurred. We understand that there are still options on the table that need to be evaluated, but we believe that can be handled in the work item. We are ok to defer to “low MSD” as a work item to Rel-18 as commented in the intermediate round as a way to balance the workload. |
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### Summary

Moderator summarizes discussion status and provide the recommendation.

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|  | **Status summary** |
| **Sub-topic #3-X XXX** | Recommendations: |
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# Topic #4: Improved MSD

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Title** | **Sourcing company** |
| [RP‑212364](file:///C:\\Users\\d00375225\\AppData\\Local\\Temp\\Rar$EXa6264.33390\\docs\\RP-212364.zip" \t "_blank) | Way forward on "Improved MSD" and "Lifting the restriction on MOP imposed by PC" | Nokia, Nokia Shanghai Bell |

## Initial round

### Comments & responses

**Background information:**

RAN#92-e tasked RAN4 to study on “low MSD” and signalling. In RAN4#100e, there was no conclusions on how to address this topic. The discussions were summarized in R4-2115012. And the following observations were provided by the corresponding moderator in RAN4 for this topic.

***Moderator observations:***

* *Current status in RAN4 is mainly related to not agreeing on the “low MSD” objective and basically whether it is to:*
* *Solve identified  network and operators issues due to high MSD, evaluate them and possibly capture “low MSD” (per identified combinations or example combinations) in TR (whether this requires signaling is based on improved MSD values and understanding of how “low MSD” and “minimum requirement MSD” UEs may be treated in the network)*
* *Introduce a “low/improved MSD” capability for UEs to advertise it without consideration of solving identified issues nor how UEs signaling “low MSD” versus minimum requirement UE may be treated differently in the network.*
* *Clear objectives need to be defined in a SI to allow progress in RAN4 and resolve companies split views between assessing “low MSD” for identified issues versus only introducing a signaling mechanism for UE to advertise better MSD.*

In this section, we collect the comments and responses for the proposed work item. Based on the comments, we will decide how to move forward in the next step.

**Sub-topic 4-1: Can we agree on to that both feasibility study and signalling can be conducted in parallel?**

* ***Way forward to “low MSD”***
  + ***RAN ensures that both feasibility study on how MSD behaves and study on how the signalling should look should be conducted in parallel.***

Companies are invited to provide the general comments on the above proposal.

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| **Company** | **Comments** |
| Xiaomi | We support the view that both the feasibility on MSD improvement and signalling should be studied in parallel. As the intention of this topic is to identify the solution for the high MSD inter-band CA/DC combination for avoiding performance loss due to the network may disable the band combination for all UEs in a conservative way or enable the band combination for UE with high sensitivity degradation, and in the actual network, UE can’t be always expected to transmit with maximum transmission output power, the actual desense (real time MSD) for a UE in a cell can be dynamically changed with different locations and conditions. It is therefore really meaningful and worth to study on how to treat UEs with high MSD dynamically by considering actual Tx power range as well. |
| Verizon | We agree this WF.  Mainly, an objective of work should be clarified in this RAN meeting to allow progress from RAN4. |
| OPPO | We are interested in this MSD improvement, but maybe slightly different from the understanding.  In our view, signaling is used to indicate how much MSD this UE can achieve, and then facilitate NW scheduling.   * The first step should be make it clear how much MSD UE could improve and then define requirements to guarantee UE could really achieve this improved MSD, with that then design signaling to indicate the values. * Otherwise, imagine a case that UE have bad MSD, however, this UE tell NW it can improve MSD with 5dB in order to get more resource from cell, then NW consider this UE is a good one, and configure CA/DC to it but unfortunately can only work with low MCS. |
| T-Mobile USA | We support the proposal that both feasibility study on how MSD behaves and study on how the signalling should look should be conducted in parallel.  We agree with Xiaomi that the actual desense can dynamically change based on several conditions including Tx power level. Worst case MSD might not be the best metric to use. It might be better for the UE to provide real time feedback of the current sensitivity degradation. |
| LGE | This issue has been discussed during 3~4 RAN4 meeting times. RAN4 need to study the feasibility to define the “low MSD” UE according to UE RF parameters. So LGE prefer to study the SI from Rel-18. The current UE RF parameters for MSD definition already reflected the state of art technology from UE vendor perspective. |
| CMCC | We support the way forward. |
| Apple | We think the objective is a bit vague for the way forward to “low MSD”, for example,   * It is not clear on the definition of “low” MSD, how low is considered as “low”? * What do we intend to achieve on the feasibility study and the meaning of “how MSD behaves”? * The benefit of UE capability signaling has not been clarified.   In our view, MSD has been defined as the minimum requirement under a particular worst-case test configuration. It is not meant to be used for network scheduling nor as a criterion on whether the combination can be configured or not for UE.  One alternative is that RAN4 continues the discussions in the “basket WI agenda not for block approval” and seeks for MSD improvement for new combinations based on improved practical front-end component performance without introducing capability signaling for a fictitious “low” MSD value. |
| vivo | We prefer to do the feasibility study in Rel-18 with a dedicated SI. However, for the signaling mechanism, we are still not clear whether this is needed or not. |
| Intel | We think that it should be a part of WID objectives discussion. An agreement of whether to introduce a new WI shall be made first. |
| CHTTL | We are fine with the WF. |
| Vodafone | We support the proposal and agree with the comments from T-Mobile USA / Xiaomi. |
| Nokia | We support the proposal. Regarding a comment if “low MSD” should be included into IDC WI or not, we have a different view. We think that it is good to separate “low MSD” and IDC. We think that they see the problem in different perspectives so that the respective resolutions would be different accordingly. |
| ZTE | The WF is fine with us. |
| AT&T | We support the WF. |
| KDDI | We support the way forward. |
| Huawei, HiSilicon | In general, we are fine to have MSD improvement to address the concern by operators for large values for some of the band combinations. But there are different cases with regard to the REFSENS degradation, even for the band combination with large MSD, it may have no issue for specific deployment scenario. Signaling is relevant to the MSD cases, which should be considered together. We don’t think it is meaningful to study signaling alone without taking MSD resulting factors and cases into consideration. |
| MediaTek | We can understand the intention of MSD improvement. In addition, MSD has been defined as the minimum requirement. And, MSD value can be quite different due to different mechanism. And once band combos are rich, it is not easy to improve its’ MSD with respect to standalone mode. We think MSD improvement should be studied by cases. |
| Ericsson | There are diverse discussions in RAN4 on how to improve the MSD. The solutions should be based on the outcome of the feasibility on MSD improvement. This is related to issue 4-2 where proponent suggests that RAN4 formulate the objectives. |
| Samsung | It is not clear on how the signaling and requirements can be discussed in parallel. In our understanding, MSD requirements specified in RAN4 spec is band combinations specific requirements especially considering the root cause of MSD is different for different band combinations and strongly related to UE architecture. General capability signaling may not sufficient to address different cases. |
| Skyworks | The study on signaling shall include whether the signaling is needed or not and thus discuss how the signaling is used by the network and make sure the UEs meeting the minimum requirement are not depreciated. Applicability per MSD type/overall MSD is another aspect. We do not support signaling an exact MSD value since some UEs may have much better REFSENS to start with and be thus more sensitive to additional noise. |
| Telstra | We support the WF |

**Sub-topic 4-2: Comments on how to organize the work and in which release the work could be done**

* ***Way forward to “low MSD”***
  + ***RAN tasks RAN4 to establish objectives for SI or WI.***
  + ***This topic is handled under a dedicated SI or WI in Rel-17 or 18 based on the objectives.***

Companies are invited to provide the general comments on the above proposal.

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| **Company** | **Comments** |
| Xiaomi | To solve above identified network and operators issues due to high MSD comprehensively, it is better to be handled in R 18 and get RAN2 involved, Thus we think as one objective of In-device coexistence for NR (RP-212032) is a good way to go. |
| Verizon | We agree with Nokia that this work needs to be handled a dedicated item. For the timeline of this work, it could be either in Rel-17 or Rel-18 depending on RAN4 workload although we prefer a solution early. |
| Qualcomm | Agree that formal SI or WI could be helpful. We prefer Rel-17 timeline. The work has already been ongoing in RAN4 so this new SI/WI does not increase the workload and deferring to Rel-18 would create a discontinuity in discussion of [6, 9, 12] months. |
| OPPO | Our suggestion is to consider this low MSD in Rel-18 package for further discussion considering the workload and challenges in completing Rel-17 WIs in RAN4. |
| T-Mobile USA | We would support either Rel-17 r Rel-18. We agree with Xiaomi that this could be combined with the IDC proposal in RP-212032 would be a good way to go. |
| LGE | Same as above LGE comment. We prefer to study the SI from Rel-18. There is no discontinuity issue if RAN4 can discuss this issue in high power UE WIs as RAN4 already discussed in Rel-17 and continue in Rel-18 as SI. RAN4 would study for the low MSD as a package in Rel-18 for PC2 CA/DC UE firstly. |
| CMCC | Considering the timeline, it is difficult to finalize the work in Rel-17. We think Rel-18 is more appropriate. |
| Apple | We are open for an SI to include the aspects of MSD improvement as well as network scheduling enhancement based on various MSD conditions. However, due to the concern of Rel-17 RAN4 workload, we prefer to start the SI no earlier than Rel-18. |
| vivo | Rel-18 SI would be better from RAN4 projects management perspective. |
| Intel | We are supportive of the work on improving MSD performance. Meantime, the work shall be performed in a systematic manner and different solutions shall be considered. We do not see opportunity to complete the work within Rel-17 timeframe considering limited time and high load in RF session. A new SI/WI shall be discussed as a part of Rel-18 package. |
| CHTTL | We support Qualcomm’s view. |
| Vodafone | Also agree work should be handled in a dedicated item. Same view as Verizon regarding timeline: it could be either in Rel-17 or Rel-18 depending on RAN4 workload, but we would prefer not to defer. |
| Nokia | We share a similar view with Qualcomm. |
| ZTE | We are fine with going for an SI or WI, which correctly reflects RAN4’s ongoing activies in the TU budget table. |
| AT&T | We agree with Qualcomm’s view. We would also prefer to agree to a Rel-17 SID at this RAN meeting if possible. If not possible, the previous RAN guidance to RAN4 concerning the feasibility study should be clarified so that RAN4 can make progress on the feasibility study in the November meeting. |
| KDDI | We share the view with Verizon. |
| Huawei, HiSilicon | We think this should be a release 18 study considering the workload in RAN4 and status of the discussion. As the study outcome would be generic to all affected band combinations, we think that belongs to general UE RF requirements. |
| MediaTek | We are okay for the SI from Rel-18 and will contribute Tdocs in RAN4. |
| Ericsson | We are fine with the way forward except we prefer SI. RAN will approve the SI earliest in December so realistically this will be Rel-18 SI. |
| Samsung | Given our comment above, we suggest to have dedicated SI to study the feasibility of “low MSD” and corresponding capability shall be discussed in such SI. We are open to have such SI in Rel-17 or REl-18 but Rel-18 is more reasonable considering current workload in RAN4. |
| Skyworks | Actually we have not seen any work on this other than the claim that some UE have lower MSD than the minimum requirement (which is obvious) and need to be able to signal it. In our view better UEs (REFSENS or MSD) already perform better in the network without any need for signaling or specification so the real issue is whether specific scheduler handling is needed or not. |
| Telstra | We prefer a solution in Rel-17 and agree with Xiaomi that this might be combined with the IDC proposal in RP-212032 |

### .Summary

Moderator summarizes discussion status for this round, list all the identified open issues and tentative agreements or candidate options and suggestion for next round.

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|  | **Status summary** |
| **Sub-topic #4-1 Proposal in RP 212364** | 21 companies commented.  10 companies support the proposals. But still there are many companies who questioned whether the signaling is needed and what kind of signaling should be specified. Those companies would like to first address the issue how to improve MSD.  Regarding how to improve MSD, the view is still quite diverse.  **Tentative agreements:**  None.  **Candidate options:**  In moderator view, if we want to agree on something, then we may try the following statement.   * RAN ensures that the following work should be conducted in parallel   + Feasibility study on how MSD behaves and   + Study on whether the signaling is needed and how the signalling should look   **Recommendations for intermediate round:**  Further discuss the above proposal. |
| **Sub-topic #4-2 Proposal in RP 212364** | 22 companies commented.  10 companies prefer to have a Rel-18 SI. 5 companies prefer to have Rel-17 SI/WI. 5 companies are OK with either Rel-17 or Rel-18.  Xiaomi proposed to include it in Rel-18 IDC proposal, which was supported by T-Mobile USA and Telstra.  **Tentative agreements:**  None.  **Candidate options:**   * Alternative 1: Approve a Rel-17 SI or WI for “low MSD”. (Qualcomm, CHTTL, Nokia, AT&T, Telstra) * Alternative 2: Discuss and strive to approve a Rel-18 dedicated SI for “low MSD”. (OPPO, LGE, CMCC, Apple, VIVO, Intel, Huawei, HiSilicon, Mediatek, Ericsson) * Alternative 3: Discuss “low MSD” in Rel-18 IDC proposal. (Xiaomi, T-Mobile, Telstra)   **Recommendations for intermediate round:**  Further discuss the above alternatives. |

## Intermediate round

### Comments & responses

**Sub-topic #4-2: Proposal in RP 212364**

Based on comments, in the intermediate round the following alternatives can be further discussed:

* Alternative 1: Approve a Rel-17 SI or WI for “low MSD”. (Qualcomm, CHTTL, Nokia, AT&T, Telstra)
* Alternative 2: Discuss and strive to approve a Rel-18 dedicated SI for “low MSD”. (OPPO, LGE, CMCC, Apple, VIVO, Intel, Huawei, HiSilicon, Mediatek, Ericsson)
* Alternative 3: Discuss “low MSD” in Rel-18 IDC proposal. (Xiaomi, T-Mobile, Telstra)
* Companies are invited to provide comments and responses in the following table.

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| **Company** | **Comments** |
| AT&T | We support Alternative 1 using a Rel-17 SI for “low MSD” in order to have the study outcome in time for a Rel-18 WI. The objectives should be clearly set to define the framework for the study to minimize the workload on RAN4. In our view, the goal should be to define a limited set of combination types for study and evaluate existing UE performance in those scenarios. Combination types could be low-mid-high, low-high, mid-high, etc. where MSD performance values are typically re-used when introducing new combinations. This should minimize the amount of per-band combination work during the study. |
| Qualcomm | The Rel-17 workload management seems to be the biggest concern. There are two proposals at this RAN plenary for continuing Rel-17 work – increasing MOP and lower MSD. Both of these have already been the subject of ongoing discussion in the past several RAN4 meetings, so continuing the work under a new SI/WI would not increase the RAN4 workload. However, as a compromise to help balance the workload, we suggest that RAN4 only takes on one of these two for Rel-17 and defers the other one to Rel-18. Since the increasing MOP has a WI already presented at this RAN plenary and since the low MSD received a number of comments that while companires preferred a start in Rel-17, they were willing to accept a Rel-18 start, we propose to start the increasing MOP WI now and defer the low MSD to Rel-18. |
| T-Mobile USA | We do support the dynamic aspect of the IDC proposal from Xiaomi, but could accept Alternative 1 to have a Rel-17 WI for “low MSD.” |
| OPPO | Alt 2. Similar as commented in Topic#3, our view is this work should be discussed in Rel-18 considering the challenges of completing all Rel-17 WIs in RAN4. Therefore, we **have concern** of introducing the WIs/SIs in Rel-17 from workload perspective. Continuing adding load to RAN4 in the late Rel-17 is not encouraged.  And suggest proponents to propose this topic in Rel-18 for a thorough discussion with other proposals. |
| Apple | Alternative 2 is our preference |
| Verizon | For balance of RAN4 workload, we are fine to defer the low MSD to Rel-18 as a compromise. |
| Xiaomi | Alternative 3 is our preference, but Alt 2 which seems to be the majority view is also acceptable for us. |
| CHTTL | We share the same view as AT&T. As RAN4 already discuss this in the past several RAN4 meetings, the workload will not be increased if we assign a dedicated SI/WI. The topic of increasing the MOP is also under the same situation. |
| Intel | Prefer Alternative 2. Similar to Topic #3, we consider this is as a non-spectrum WI. Rel-17 RAN4 RF TU capacity is already full till the end of Release 17. Approval of additional WI close to the completion of Rel-17 will have negative impact on the progress for the remaining projects. We prefer to discuss the potential objectives as a part of Rel-18 email discussion. Also, we think that wording of Alt 2 shall be adjusted and whether to approve the Rel-18 WI should be decided based on level of support among different proposals and it is out of scope of current discussion. |
| Telstra | Same view as T-Mobile USA |
| CMCC | In general, we think low MSD should be discussed in Rel-18 considering the workload in Rel-17.  For alt. 2: whether to have a Rel-18 dedicated SI or WI or put it in the RF umbrella WI can be further discussed.  For alt. 3: IDC may be one of the solution to solve the MSD issue, but it needs more study in RAN4.  We support to modify the alt. 2 as below:   * Discuss “low MSD” in Rel-18 RAN4 package. |
| vivo | Alt 2 is our preference. |
| LGE | LGE prefer Alt. 2 as a package of low MSD UE in dedicated SI. |
| Huawei, HiSilicon | Since MSD improvement is generic for all affected band combinations, the general part should be covered by the RF umbrella WI if the requirements are agreed to be specified based on study in Rel-18. We think the modification by CMCC on Alt 2 is more appropriate. |
| Samsung | As we commented in initial round, Rel-18 SI is preferred. Workload is an issue especially for RAN4 in the later stage of release. Most of other WG led items are supposed to be discussed and completed in next two quarters. |
| ZTE | As a compromise, we can accept Alternative #2 if increasing MOP WI is approved as a Rel-17 WI. |
| KDDI | Considering the RAN4 work load, Alt2 seems to be reasonable. |
| MediaTek | We are fine to Alt 2. |
| Skyworks | We do not agree that Alt1 would not increase the workload , so far the discussion in RAN4 has only been on principles and handling of low MSD without much technical evaluation of how much, for which types of MSD, for which example cases…for this reason we prefer Alt2 and we also urge the SI/WI to be clear on what should be investigated rather than just study “low MSD” and signaling. |
| Ericsson | We support alternative 2. In general, and regardless of release, it would be beneficial to specify MSD requirements for the cases in which IMD falls just outside the wanted channel or outside the PRB allocations affected by IMD (impact on PDCCH and PDSCH may be different in the latter case). This is also interesting in relation to any information provided by the UE. |
| Nokia | Alternative 1 is the most efficient way since if we discuss this in Rel-18, the discussion starts from Q3 2022 and we would like to re-emphasize that the discussion has been discussed in RAN4 thus far. Hence, the work should not be counted as additional one, even if a new Rel-17 SI or WI for this topic is approved.  Nonetheless, if approving several new WIs/SIs for Rel-17 now impacted on the number of future RAN4 meetings, the WIs/SIs should be handled not to increase the number of the meetings further, e.g., the number of the WIs or SIs is limited or the scope is down-selected etc., considering the whole RAN4 workload. |
| Vodafone | Alternative 1 is our preference. Similar views to AT&T. |
| Orange | We support Alt1, and if not possible Alt2 |

**Sub-topic #4-1 (Objectives) Proposal in RP 212364**

* RAN ensures that the following work should be conducted in parallel
  + Feasibility study on how MSD behaves and
  + Study on whether the signaling is needed and how the signalling should look

Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| AT&T | We agree to study the “low MSD” and signalling, if needed, in parallel. We would prefer that the first bullet read as “Feasibility study on “low MSD” for CA and DC in Rel-17”. |
| T-Mobile USA | We support the parallel study on MSD and signalling. |
| OPPO | Thanks moderator for the proposal. Although we are interested in this MSD improvement, maybe slightly different from the understanding of how this work should be conducted.  As commented in 1st round, our view is that signaling is used to indicate how much MSD this UE can achieve, and then facilitate NW scheduling.  The first step should be make it clear how much MSD UE could improve and then define requirements to guarantee UE could really achieve this improved MSD, with that then design signaling to indicate the values.  Otherwise, without clear understanding of how the improved MSD look like in RAN4, it is not clear how to decide whether signaling is needed or not, and not clear how RAN2 could design the signaling.  Therefore, our proposal is to study these two items in **serial** in Rel-18. |
| Apple | It is still not clear to us on the meaning of “how MSD behaves” and what is feasible or not feasible to be from the study? |
| Xiaomi | We support the parallel study on the feasibility of MSD improvement and signalling. The detail objective can be discussed under R18. |
| Telstra | We support the proposed objectives |
| CMCC | Objectives can be discussed during RAN4 package discussion. |
| vivo | We share similar view with OPPO and Apple. Before having clear understanding on how the low MSD will be defined, we think RAN4 is wasting meeting time to discuss “Potential” signaling. |
| LGE | LGE can agree with these objectives. And prefer to treat feasibility and signaling issues as sequential in a single SI. |
| Huawei, HiSilicon | We agree with OPPO, before we have better understanding how to improve the MSD, it is too early to consider the signaling aspect. But anyway, the objectives should be further discussed for the Rel-18 topic. |
| Samsung | All Rel-18 items shall be discussed together as a package. |
| KDDI | We are fine with the proposed objectives. |
| Skyworks | Study of “how MSD behaves” is too vague for any fruitful discussion in RAN4. It should state which MSD type, an example combination to be studied (to be decided), assess under which condition the MSD can be improved (RF component performance, PCB isolation, antenna architecture and isolation). |
| Ericsson | It is not clear what is meant by parallel work. Also the wording is confusing. Anyway all aspects should be part of the SI on MSD improvement. The need for signaling can be based on the outcome of study and should not be assumed from the start. |
| Nokia | We are ok with the proposal and also OK with alternative by AT&T |
| Vodafone | We support the parallel study on MSD and signaling. |
| Orange | We support the objectives |

### Summary

Moderator summarizes discussion status for this round, list all the identified open issues and tentative agreements or candidate options and suggestion for next round.

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #4-2** | **Topic #4: Improved MSD**  The situation does not change too much. More companies supported Alt 2 considering RAN4 workload. Regarding to objectives, there were still diverse views on signalling. Based on comments in this topic and also Topic #3, moderator would like to propose to endorse the following proposal and close this topic.   * **Proposal #4**: Discuss and strive to approve “low MSD” in Rel-18 new WI/SI package |

## Final round

### Comments & responses

**Sub-topic #4-2: Proposal in RP 212364**

Based on the status of the intermediatel round, firstly moderator would like to check if the Proposal #4 is agreeable.

* **Proposal #4**: Discuss and strive to approve “low MSD” in Rel-18 new WI/SI package

Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| T-Mobile USA | We prefer that this be a Rel-17 WI. Given the need to prioritize between WI proposals being discussed in this thread, the improved MSD work is the top priority for us for Rel-17. There is such a wide discrepancy between MSD specs and performance for some band combinations in the field that our network colleagues don’t take the MSD specs seriously. |
| AT&T | We can agree the “low MSD” WI would be part of Rel-18 as discussed in RAN#92e. However, the “low MSD” SI should be completed in the Rel-17 timeframe.  As mentioned in Topic #3, we think that the feasibility study on “low MSD” in Rel-17 timeframe was already confirmed by RAN at RAN#92e based on wide operator support and RAN4 was tasked accordingly. The only addition at this meeting was the proposal to formalize the request into a SI since RAN4 was not able to come back to RAN in RAN#93e with any outcome due to the different views in RAN4 as to the extent of the objectives. |
| Bell Mobility | We agree with T-Mobile’s observation and MSD work is the top priority for us as well. |
| Qualcomm | We would prefer that this work be conducted in Rel-17 since it has been recognized by most companies to be valuable. In recognition, however, of the workload constraints in RAN4 we are willing to defer a work item for low MSD to Rel-18. |
|  |  |
|  |  |

**Sub-topic #4-1 (Objectives) Proposal in RP 212364**

It is difficult for group to agree to do analysis for improvement of MSD and signaling in parallel. So moderator would like to suggest to endorse the following proposal as outcome for future discussion.

* **Proposal #5:** RAN ensures that the following work should be conducted in parallel
  + Feasibility study on how MSD behaves and
  + Study on whether the signaling is needed and how the signalling should look

Companies are invited to provide comments and responses in the following table.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| T-Mobile USA | This is fine with us, but we prefer that it be in Rel-17. |
| AT&T | We are OK with proposal #5 but also support TMUS comment that this study should be part of Rel-17. |
| Bell Mobility | Fine with us although we support T-Mobile that the study should be part of Rel-17 |
| Qualcomm | Generally, we’re ok with the proposals but we think “feasibility study of how MSD behaves” is ambiguous. Can we be more precise about what this means and how this would translate to WI objective? |
|  |  |
|  |  |

### Summary

Moderator summarizes discussion status and provide the recommendation.

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #4-X XXX** | Tentative agreements:  Candidate options:  Recommendations: |
|  |  |
|  |  |

# Summary of Recommendations

## Outcome of intermediate round

**Topic #1: APT 600MHz NR band**

The situation is unchanged in intermediate round compared to previous round. Almost half of companies supported a new WI while the other half were against. The situation is as follows:

* Alternative 1: Do not start a WI until 3GPP receives the AWG decision on a single option between B1 and B2. (Apple, Skyworks, Telstra, Qualcomm, Intel)
* Alternative 2: Start a WI with study phase and checking point for AWG decision (Spark NZ, Nokia, Huawei, Ericsson, CBN)
  + During study phase, RAN4 should focus on generic requirements for both B1 and B2 and identify which requirement specific for B1 and B2 respectively.
  + Start the normative work for RAN4 requirements after receiving AWG decision

Moderator would like to propose the following compromise solution.

* **Proposal #1**: Approve a WI for APT 600MHz NR band in RAN#93e but put it on hold until 3GPP receives the information about decision on options for band plan in AWG-29 in March 22.

**GTW discussion on Wednesday:**

Companies still had concern on Proposal #1. Ericsson proposed to extend SI. So there are three alternatives which can be discussed further in final rounds.

* Alternative 1: Do not start a WI until 3GPP receives the AWG decision on a single option. (Apple, Skyworks, Telstra, Qualcomm, Intel)
* Alternative 3 (Proposal #1 in intermediate round: Approve a WI for APT 600MHz NR band in RAN#93e but put it on hold until 3GPP receives the information about decision on options for band plan in AWG-29 in March 22.
* Alternative 4: Extend the SI which is to be closed in RAN#93-e to March 22 to continue discussion on options based on the feedback of AWG.

**Topic #2: HPUE PC2 for NR FDD band**

The situation is as below:

* Alternative 1: Approve a spectrum related WI for FDD PC2 high power UE in Rel-17 …(Qualcomm, Xiaomi, Telstra, Telecom Italia, Huawei, HiSilicon, ZTE, Ericsson, China Unicom, Orange)
* Alternative 2: Postpone the new WID for FDD PC2 high power UE to Rel-18 (Apple, Vivo, Samsung, Mediatek. Skyworks)
* Either Alternative 1 or Alternative 2 (OPPO, CMCC, LGE, Vodafone)

Moderator would like to provide a compromise solution based on Alternative 1 capturing companies’ comments.

* **Proposal #2**: Endorse the Alternative 3 for HPUE PC2 for NR FDD band
  + Alternative 3:
    - Approve a spectrum related WI for FDD PC2 high power UE in Rel-17
      * Covering NR band n1 and n3
      * Using UE-implementation based solution, i.e., P-MPR solution, as baseline for SAR issue, and have further discussion on other SAR solutions, which was not discussed in SI, if agreeable.
      * Further evaluate the impact of PC2 on MSD when specifying the MSD requirements
      * Based on 2Tx architecture
      * Taking all the outcome from SI captured in TR 38.861 into account
    - Discuss the basket work item to cover other FDD PC2 bands in Rel-18

**GTW discussion on Wednesday:**

Skyworks and Ericsson proposed to add 1Tx as baseline. So we can further discuss that part in final round.

**Topic #3: Increasing UE power high limit for CA and DC**

Most of companies did not change their views. The situation of discussion is as follows:

* Alternative 1: Approve a Rel-17 WI for increasing UE power high limit for CA and DC (Verizon, Qualcomm, T-Mobile, China Telecom, Telecom Italia, Vodafone, Nokia, ZTE, AT&T, Ericsson, Nokia, Orange)
* Alternative 2: Discuss and strive to approve the new item for study of increasing UE power high limit for CA and DC in Rel-18 (OPPO, LGE, CMCC, Apple, VIVO, Intel, Huawei, Mediatek, Xiaomi, Skyworks)

AT&T and Qualcomm provided compromise solutions. And Apple and Mediatek proposed Option 3 which is the mixture of Option1and Option 2. Based on them and considering balancing the workload in RAN4 as proposed by Qualcomm, moderator would like to propose to agree on the following alternative:

* **Proposal #3:** Endorse the Alternative 3 for increasing UE power high limit for inter-band CA and DC
  + Alternative 3: Endorse the following proposals as a package considering balancing RAN4 workload
    - Approve a Rel-17 SI to down-select the option between Option 1, Option 2 and other options (if any), and discuss and strive to approve objectives in Rel-18 WI/SI for increasing UE power high limit for inter-band CA and DC.
    - Defer “low MSD” to Rel-18 new SI/WI package discussion.

NOTE: Option 1 and Option 2 for reference based on Nokia and China Telecom comments in intermediate round

1. Consider the two options and study the feasibility and impacts for option 1.
   * Option 1: No explicit power class signalling
     + Allow UE to transmit the sum of the individual rated PA power classes by lifting the restriction from the Power Class for UL inter band CA or DC, i.e., PPowerClass,CA is replaced with 10\*log10∑pPowerClass,c.
     + Clarification on impact of duty cycle reporting should be addressed.
   * Option 2: define a new power class for CA and DC
     + Introduce new power classes with necessary requirements

**GTW discussion on Wednesday:**

Some companies still had concern on the proposal. Operators supported to start the work.

**Topic #4: Improved MSD**

The situation does not change too much. More companies supported Alt 2 considering RAN4 workload. Regarding to objectives, there were still diverse views on signalling. Based on comments in this topic and also Topic #3, moderator would like to propose to endorse the following proposal and close this topic.

* **Proposal #4**: Discuss and strive to approve “low MSD” in Rel-18 new WI/SI package

## Outcome of final round