**3GPP TSG-RAN Meeting #93-e RP-21XXXX**

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

**Agenda item:** 9.1.4

**Source:** Moderator (RAN4 Chair)

**Title:** Email discussion summary for [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

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| **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.

|  |  |
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| **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. |
| 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 |
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**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. |
| Skyworks | Our preference is to start the work only when a single band configuration is available from AWG |
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**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. |
| 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 |
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**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.

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| **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 |
| Skyworks | For completion date we need to have a single option to work on which would require less effort |
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### 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** | XX companies commented.  **Tentative agreements:**  **Candidate options:**  **Recommendations for intermediate round:**  Further discuss the following issues:   * xx |
| **Sub-topic #1-2 Options B1 and B2** | XX companies commented.  **Tentative agreements:**  **Candidate options:**  **Recommendations for intermediate round:**  Further discuss the following issues:   * xx |
| **Sub-topic #1-3 Objectives** | XX companies commented.  **Tentative agreements:**  **Candidate options:**  **Recommendations for intermediate round:**  Further discuss the following issues:   * xx |
| **Sub-topic #1-4 Impacted spec and timeline** | XX companies commented.  **Tentative agreements:**  **Candidate options:**  **Recommendations for intermediate round:**  Further discuss the following issues:   * xx |

## Intermediate round

### Comments & responses

In this round, the following issues need be further discussed and addressed.

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

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| **Company** | **Comments** |
| XXX |  |
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### 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 #1-X XXX** | Tentative agreements:  Candidate options:  Recommendations for final round: |
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## Final round

### Comments & responses

*Based on the status of the final round, recommendations will be provided.*

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
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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: |
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# Topic #2: HPUE PC2 for NR FDD band

## Companies’ contributions summary

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| **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.

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

The following objectives are proposed in the WID.

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**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.

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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. |
| 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 |

**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.

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| --- | --- |
| **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. |
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### 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 #2-1 General** | XX companies commented.  **Tentative agreements:**  **Candidate options:**  **Recommendations for intermediate round:**  Further discuss the following issues:   * xx |
| **Sub-topic #2-2 Objectives** | XX companies commented.  **Tentative agreements:**  **Candidate options:**  **Recommendations for intermediate round:**  Further discuss the following issues:   * xx |
| **Sub-topic #2-3 Specs & timeline** | XX companies commented.  **Tentative agreements:**  **Candidate options:**  **Recommendations for intermediate round:**  Further discuss the following issues:   * xx |

## Intermediate round

### Comments & responses

Based on the initial round discussion, the following issue needs be discussed in the intermediate round.

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

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| --- | --- |
| **Company** | **Comments** |
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### 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 #2-X XXX** | Tentative agreements:  Candidate options:  Recommendations for final round: |
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## Final round

### Comments & responses

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
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### Summary

Moderator summarizes discussion status and provide the recommendation.

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|  | **Status summary** |
| **Sub-topic #2-X XXX** | Recommendations: |
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# Topic #3: Increasing UE power high limit for CA and DC

## Companies’ contributions summary

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| **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 |
| 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 |

**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. |
| 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.

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| **Company** | **Comments** |
| XXX |  |
| Apple | A commented earlier, our preference is to have an SI no earlier than Rel-18. |
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### 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** | XX companies commented.  **Tentative agreements:**  **Candidate options:**  **Recommendations for intermediate round:**  Further discuss the following issues:   * xx |
| **Sub-topic #3-2 Objectives** | XX companies commented.  **Tentative agreements:**  **Candidate options:**  **Recommendations for intermediate round:**  Further discuss the following issues:   * xx |
| **Sub-topic #3-3 Specs & timeline** | XX companies commented.  **Tentative agreements:**  **Candidate options:**  **Recommendations for intermediate round:**  Further discuss the following issues:   * xx |

## Intermediate round

### Comments & responses

Based on the initial round discussion, the following issues/questions need be addressed/answered.

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

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| **Company** | **Comments** |
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### 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-X XXX** | Tentative agreements:  Candidate options:  Recommendations for final round: |
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## Final round

### Comments & responses

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

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| **Company** | **Comments** |
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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.

|  |  |
| --- | --- |
| **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. |
| 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. |

**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.

|  |  |
| --- | --- |
| **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. |
| 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. |

### 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 #4-1 Proposal in RP 212364** | XX companies commented.  **Tentative agreements:**  **Candidate options:**  **Recommendations for intermediate round:**  Further discuss the following issues:   * xx |
| **Sub-topic #4-2 Proposal in RP 212364** | XX companies commented.  **Tentative agreements:**  **Candidate options:**  **Recommendations for intermediate round:**  Further discuss the following issues:   * xx |

## Intermediate round

### Comments & responses

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
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### 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-X XXX** | Tentative agreements:  Candidate options:  Recommendations for final round: |
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## Final round

### Comments & responses

*Based on the status of the intermediatel round, the issues will be provided by moderator and further comments will be collected.*

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

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| --- | --- |
| **Company** | **Comments** |
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### Summary

Moderator summarizes discussion status and provide the recommendation.

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

# Summary of Recommendations