**3GPP TSG-RAN WG4 Meeting # 102-e R4-2206343**

**Electronic Meeting, February 21 – March 3, 2022**

**Agenda item:** 8

**Source:** CMCC

**Title:** Email discussion summary for [102-e][143] R17\_feature\_list

**Document for:** Information

1. Introduction

This email discussion focuses on Rel-17 UE feature list discussion (agenda 8). The feature list agreed in last meeting is R4-2202400.

Since RAN2 only formally capture the input of feature list from other working group by the end of first week during meeting, following RAN4 leadership’s guidance, we plan to **send one LS on Friday of first week and send another one if needed on Thursday of the second week.**

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| **TDoc** | **Title** | **Source** |
| [**R4-2203657**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203657.zip) | UE features for enhanced IIoT and URLLC | Nokia |
| [**R4-2203809**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203809.zip) | Further discussion on R17 feature list | Apple |
| [**R4-2203851**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203851.zip) | A new Rel-17 per-FR MG capability based on Per BC | Qualcomm Incorporated |
| [**R4-2204054**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204054.zip) | Inputs to Rel-17 NR UE features for measurement gap enhancement and UE power saving enhancement | MediaTek inc. |
| [**R4-2204428**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204428.zip) | Discussion on Rel-17 RAN4 UE feature list | Intel Corporation |
| [**R4-2204479**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204479.zip) | Continue discussion on capability signaling for HPUE NR DC | MediaTek Inc. |
| [**R4-2204484**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204484.zip) | draft LS to RAN2 for NR CA\_DC power class | MediaTek Inc. |
| [**R4-2204651**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204651.zip) | Update on Rel-17 RAN4 UE feature list for NR | vivo |
| [**R4-2204687**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204687.zip) | Discussion on Fs\_inter for FR2-1 inter-band DL CA based on CBM within same frequency group | LG Electronics |
| [**R4-2205191**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205191.zip) | On Rel-17 feature list | Huawei, HiSilicon |
| [**R4-2206051**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206051.zip) | On rel-17 UE features | Nokia, Nokia Shanghai Bell |
| [**R4-2206098**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206098.zip) | R17 UE feature list proposal | Qualcomm communications-France |

1. NR\_pos\_enh

**Issue 14-1: New UE features for NR positioning (R4-2204651, vivo)**

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| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** | **Applicable to the capability signalling exchange between UEs (V2X WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 14NR\_pos\_enh | 14-2 | PRS measurement for reduced sample in RRC\_inactive state | Capability of supporting reduced number of samples (M=1) for PRS measurement in RRC\_inactive state | [27-17] | no |  | The reduced number of samples (M=1) for PRS measurement in RRC\_inactive state cannot be supported. The UE is assumed to support M=4 only. | Per UE | No | No | N/A |  | Optional with capability signaling |
| 14. NR\_pos\_enh | 14-3 | PRS measurement without MG | Capability for the threshold used to be compared against with the Rx timing difference to determine whether the PRS from the non-serving cell satisfy the condition of PRS measurement outside MG. | [27-3-2] | yes |  |  | Per UE | No | No | N/A | The candidate threshold values: [CP length, half of the symbol, half of slot, 1ms] | Optional with capability signaling |

**Recommended WF:**

**Continue to discuss in RRM session, and capture the agreements in UE feature list.**

## 14.1 Summary for 1st round

**Recommended WF: Continue to discuss in email thread#230 in RRM session**

1. NR\_ext\_to\_71GHz

**Issue 15-1: UE support of max CBW for supported SCS**

Option 1 (R4-2203809, Apple)

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| X.Extending current NR operation to 71GHz | X-1 | UE support of max. CBW for supported SCS | Capability of supported CBW1. 400MHz for 120kHz SCS
2. {800, 1600} MHz for 480kHz SCS
3. {800, 1600, 2000} MHz for 960kHz SCS

NOTE 1: this capability may need to be split into three capabilities, i.e. one for each supported SCSNOTE 2: 100 MHz is a mandatory CBW if the UE supports 120 kHz SCSNOTE 3: 400 MHz is a mandatory CBW if the UE supports 480 kHz or 960 kHz SCSNOTE 4: The UE shall signal at least one of these components to the network |  | yes | no | The network does not know if UE can transmit or receive with a specific CBW | per Band | No | No |  |  | Optional with capability signalling |

Option 2 (R4-2204428, Intel)

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| Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | Consequence if the feature is not supported by the UE | Type | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 15-2 | FR2-2 channel bandwidths for each SCS in each band for DL and UL for a single CC | Support of FR2-2 channel bandwidths 1) 120 kHz SCS: {100, 400} MHz CBW2) 480 kHz SCS: {400, 800, 1600} MHz CBW3) 960 kHz SCS: {400, 800, 1600, 2000} MHz CBW | FFS | Yes | No | UE cannot support some UE channel bandwidths | Per band | N/A | Applicable to FR2-2 only | N/A | UE indicating the support of specific SCS per band (RAN1 features X-Y) is required to support all CBWs corresponding to this SCSNo additional capability signalling is needed. | NA |

Option 3 (R4-2206051, Nokia): As each SCS is optional to support, further optionality on maximum channel bandwidth support is not required.

**Recommended WF:**

**TBA**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Qualcomm** | Option 2 seems a lot cleaner. The notes in Option 1 are not clear. Why does the UE have to signal at least one of those components? |
| **ZTE** | Option 2. For Note 2 in Option 1, since 100MHz is not included in the capability for 120kSCS, it is a bit confusing. |
| **Apple** | The rationale behind our proposal is detailed in R4-2203805, covering aspects related to UE implementation challenges in supporting larger than 400MHz CBWs such as power consumption, power control, DPD, ADC/DAC, baseband processing, etc., different UE types, and deployment scenarios. While support of 480/960kHz SCS is optional, it is meaningful and necessary to decide which of their associated CBWs is optional/mandatory to UEs. For the UEs that can support 400MHz but not 800/1600/2000MHz, they will have a chance to support 480/960kHz SCS, which would allow more UEs to support and use such SCSs. Without such a granularity, those UEs would be forced to claim that they don’t support 480/960kHz SCSs, which is clearly a loss to operators who choose to deploy such SCSs. It is also worth noting that considering UE support of 400MHz is optional in FR2-1, mandating the support of 400MHz for 480/960kHz SCS indicates an increase in UE implementation complexity.To Qualcomm: if no signaling from the UE means UE does not support the optional bandwidth, we agree Note 4 can be removed.To ZTE: The signaling is for UE to indicate if it supports optional CBWs. For 120kHz SCS, only 400MHz CBW is proposed to be optional and 100MHz CBW is mandatory. |
| **Nokia** | We support option 2 and 3, which are aligned. When considering the optionality of channel bandwidths, it needs to be kept in mind that each SCS is already optional. Also considering that operating band n263 being defined now is 14 GHz wide. It does not make sense to limit mandatory UE support to only 100 MHz ChBW. |
| **Qualcomm** | Based on Apple’s replies, it seems all options are more or less aligned. We also agree with Nokia that each SCS is already optional so support of a channel BW comes in a package with SCS support. We disagree with Nokia’s proposal that further optionality of CBW is not necessary, a UE can support only some of the channel BWs defined for a certain SCS.The signaling should be designed such that if a UE supports a certain SCS, it has to support the minimum channel BW for that SCS and the other channel BWs are optional. |
| **Huawei** | Mandatory minimum CHBW with the optional 480/960 SCS is a reasonable baseline. FR2-1 capabilities baseline (e.g. optional 400MHz for 120kHz; unless it is minimum CHBW for higher SCS) is also reasonable to reuse FR2-1. Therefore slight preference to take option 1 as starting point for further adjustments (especially Notes needs to be clarified). |
| **Intel** | Option 2 is still our preference.We can also be open to discuss if option 1 is the right way to converge. We suggest to have a discussion on this issue in the GTW session on Friday. |
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**Issue 15-2: Initial transmit timing error**

Option 1 (R4-2203809, Apple)

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
|  | X-6 | Initial transmit timing error | Depend on the outcome of ongoing discussion. There is a possibility of having UE capability on Te and the supported SSB and UL SCS combinations |  |  |  |  |  |  |  |  |  | Optional with capability signalling |

**Recommended WF:**

**TBA**

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| --- | --- |
| **Company** | **Comments** |
| **Qualcomm** | Discussion should be postponed until the technical issues with the initial transmit timing is solved |
| **ZTE** | Similar view as Qualcomm. |
| **Apple** | As the RRM discussion on how to define the requirement on UE initial transmit timing error is ongoing, this proposal of UE capability serves as a placeholder and depends on the conclusion of the RRM discussion. |
| Nokia | Not needed.The capabilities for SCS in DL and UL from R1-2200780 should be enough. For the SCS that a UE supports, we understand that the UL timing requirements are fundamental for the operation in the network and cannot be made optional.  |
| Huawei 2 | This feature item depends on discussion in RRM session. |
| Intel | We suggest waiting for the outcome in RRM discussions. |

**Issue 15-3: Improved ON/ON transient period**

Option 1 (R4-2203809, Apple): postpone the discussion

Option 2 (R4-2204428, Intel):

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| Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | Consequence if the feature is not supported by the UE | Type | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 15-3 | [Improved ON/ON transient period] | 1) Support of improved ON/ON transient period of X < 5us (X is FFS) | FFS | Yes | No | UE does not support improved ON/ON transient period and support 5us transient period | Per UE | N/A | Applicable to FR2-2 only | N/A | Further RAN4 discussion is required on whether to support improved ON/ON transient period and X value | Optional with capability signalling |

Option 3 (R4-2206051, Nokia): For optional ON-ON transient time, only one value among 1 us or 2 us is specified

**Recommended WF:**

**TBA**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | A technical decision on this should be made first, then we can discuss how the capability would look like. |
| ZTE | Option 3. |
| **Apple** | We prefer Option 1. According to our understanding, this issue has now been raised in the context of Rel-18 RAN4-led package proposals, and we are fine to continue this discussion in RAN plenary. |
| Nokia | There is a parallel discussion on this in thread 134. The actual format of the UE feature can only be finalized after the technical discussion has concluded, however option 2 seems to provided a good starting point. Our proposal in technical discussion is aligned with option 3 here, so in conclusion we think the baseline in option 2 should be updated to adopt either 1 or 2 us transient period. |
| AT&T | We prefer Option 2 and have identified this in thread 134 also. We are also OK with the suggestion from Nokia that we align Option 2 with the outcome of the discussion in thread 134. |
| Huawei 2 | Option 1.  |
| Intel  | We are OK to wait for conclusion in thread 134. |

## 15.1 Summary for 1st round

**Issue 15-1: UE support of max CBW for supported SCS**

**Option 1 (Apple, Huawei)**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| X.Extending current NR operation to 71GHz | X-1 | UE support of max. CBW for supported SCS | Capability of supported CBW1. 400MHz for 120kHz SCS
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3. {800, 1600, 2000} MHz for 960kHz SCS

NOTE 1: this capability may need to be split into three capabilities, i.e. one for each supported SCSNOTE 2: 100 MHz is a mandatory CBW if the UE supports 120 kHz SCSNOTE 3: 400 MHz is a mandatory CBW if the UE supports 480 kHz or 960 kHz SCS~~NOTE 4: The UE shall signal at least one of these components to the network~~ |  | yes | no | The network does not know if UE can transmit or receive with a specific CBW | per Band | No | No |  |  | Optional with capability signalling |

**Option 2 (Qualcomm, ZTE, Nokia, Intel)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | Consequence if the feature is not supported by the UE | Type | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 15-2 | FR2-2 channel bandwidths for each SCS in each band for DL and UL for a single CC | Support of FR2-2 channel bandwidths 1) 120 kHz SCS: {100, 400} MHz CBW2) 480 kHz SCS: {400, 800, 1600} MHz CBW3) 960 kHz SCS: {400, 800, 1600, 2000} MHz CBW | FFS | Yes | No | UE cannot support some UE channel bandwidths | Per band | N/A | Applicable to FR2-2 only | N/A | UE indicating the support of specific SCS per band (RAN1 features X-Y) is required to support all CBWs corresponding to this SCSNo additional capability signalling is needed. | NA |

**Option 3 (Nokia):** As each SCS is optional to support, further optionality on maximum channel bandwidth support is not required.

**Recommended WF: discuss on Friday GTW session if time allowed**

**1st issue to be discussed: whether further optionality on channel bandwidths for optional SCS is needed**

**If the answer is Yes, discuss whether to choose option 1 or option 2**

**Issue 15-2: Initial transmit timing error**

**Recommended WF: Continue to discuss in RRM session in 2nd round**

**Issue 15-3: Improved ON/ON transient period**

**Recommended WF: Continue to discuss in email thread#134 in 2nd round**

1. NR\_RF\_FR1\_enh.

**Issue 16-1: SCell dropping**

Option 1 (Huawei, R4-2205191)

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| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** | **Applicable to the capability signalling exchange between UEs (V2X WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 16. NR\_RF\_FR1\_enh | 16-7 | [Support RRC configuration to prevent SCell dropping for CA] | UE capability to indicate whether to support the function.NW configure a relative parameter for serving cells which is a UE specific RRC signalling for a set of values based on possible proportion of channel BW or allocated RB resources among the CCs, and the appropriate parameter according to CBW ratio or dynamic RB allocation ratio can be fast activated/deactivated by MAC-CE or DCI for each scheduling. The parameter set includes values of 10log10{5%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 100%}. |  | Yes | N/A | [UE may drop SCell without enough transmission power according the current power control mechanism for CA] |  Per BC | No  | No | N/A |  | Optional with capability signalling |

**Recommended WF:**

**TBA**

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| **Company** | **Comments** |
| **ZTE** | **The feature is still not clear enough, subject to the final solution.** |
| **Apple** | This appears to be a more complex proposal than even currently considered so far; we recommend postponing this discussion to Rel-18, if a solution based on currently considered options is not possible to agree in Rel-17. |
| **Huawei 2** | Pending technical discussion in thread [124] |

**Issue 16-2: PHR reporting for CA**

Option 1 (Huawei, R4-2205191)

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| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** | **Applicable to the capability signalling exchange between UEs (V2X WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 16. NR\_RF\_FR1\_enh | 16-8 | PHR reporting for CA | Support PCMAX,CA , and PHRCA reporting for CA |  | Yes | N/A | NW may not get the accurate information for the power head room for CA | Per BC | No | No | N/A |  | Optional with capability signalling |

**Recommended WF:**

**TBA**

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | What is this feature for? We already have a lot of options for PHR reporting. More discussion is clearly needed before anything can be agreed. |
| ZTE | More discussion required. |
| **Apple** | We recommend some further discussion about the description of this component. In many ways, this capability would be dependent on the overall SCell dropping discussion. Also, whether to introduce this capability or not, should be decided first as well (in email thread 124). Overall, defining Pcmax\_CA is a big change to the overall power control design, and this also potentially can have impact on RAN1. |
| **Huawei 2** | This topic is under discussion in thread [124] |

**Issue 16-3: Minor changes on feature group 16-4, 16-5, 16-6**

Option 1 (Huawei, R4-2205191)



**Recommended WF:**

**Some minor changes on the prerequisite feature groups are proposed above. Companies please check whether the changes are acceptable.**

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Is the numbering change the only change? |

## 16.1 Summary for 1st round

**Issue 16-1: SCell dropping**

**Recommended WF: Continue to discuss in email thread#124 in 2nd round**

**Issue 16-2: PHR reporting for CA**

**Recommended WF: Continue to discuss in email thread#124 in 2nd round**

**Issue 16-3: Minor changes on feature group 16-4, 16-5, 16-6**

Option 1 (Huawei, R4-2205191)



**Recommended WF: The only changes are the numbers of prerequisite features. Capture the updates in the UE feature list.**

1. NR\_RF\_FR2\_req\_enh2

**Issue 17-1: UE features for UL gap for Tx power management (R4-2203809, Apple)**

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| UL gap for Tx power management  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2-2 | Support of UL gap configurations for Tx power management | Capability of supporting UL gap configurations needed for performing BPS sensing for Tx power management. The UE indicating this capability shall meet the corresponding enhanced UE requirements defined in Section TBD.  | 17-1 | yes | no | The network does not know if a UE supports specified UL gap configurations needed for Tx power management | Per UE | No | FR2 only |  |   | Optional with capability signalling |
|  | 2-4 | Support of UL transmission in FR2 bands within the UL gap when an UL gap is activated  | UE indicates the constituent band(s) for which UL transmission is supported within the UL gap when an UL gap is activated in inter-band UL CA.  |  |  |  | The network does not know if the UE can have UL transmission within the UL gap when an UL gap is activated in inter-band UL CA.  | Per FS (per band per band combination) | No | FR2 only |  |  | Optional with capability signalling |

**Recommended WF:**

**TBA**

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| --- | --- |
| **Company** | **Comments** |
| **Apple** | For capability 2-2, due to different UE implementations, it is very difficult to mandate an UL gap configuration for all UEs. Instead, it is sensible to leave it optional. Furthermore, we believe even though all four gaps are optional, network vendors still have flexibility in deciding to implement only the most representative/common gaps after consultation with UE vendors and operators, as is the case with so many other optional features.As discussed in our contribution R4-2203749, whether the UE should stop all UL transmission across different FR2 bands depends on the exact RF architecture and Body proximity sensing implementation. If independent RF architecture is used in different FR2 band for both sensing and UL transmission, then it might be possible that the UE only stops UL transmission for one FR2 band. However, if some RF components are shared, when UL gap is configured and activated for a band, all active FR2 UL CC will be impacted regardless of whether the active FR2 UL CC is in a band that supports UL gap capability or not.  Therefore, capability 2-4 is proposed to allow different implementations. |
| Nokia | Is there a need for indicating which UL gap patterns the UE support? |

**Issue 17-2: UE features for UL gap for coherent UL MIMO (R4-2203809, Apple)**

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| UL gap for coherent UL MIMO  | 2-3 | Support of UL gap for coherent UL MIMO  | Capability of performing coherent UL MIMO calibration in UL gap  |  | yes | no | UE does not support UL gap for coherent UL MIMO calibration  | FR2 only  | No | No |  |  | Optional with capability signalling |

**Recommended WF:**

**This feature had been discussed in last meeting and captured in the feature list with []. Further discussion is needed.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Any reason why these are split? |
| **Apple** | As proposed, we think support of UL gap for coherent UL MIMO should be a UE capability. |

**Issue 17-3: Support of Fs\_Inter for CBM inter-band CA**

Option 1 (Huawei, R4-2205191):

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 17. NR\_RF\_FR2\_req\_enh2 | 17-4 | Support of Fs\_Inter for CBM inter-band CA | Support for frequency separation class for inter-band CA with CBM (Fs\_Inter):Same values as intra-band non-contiguous CA (Fs) are supported, frequency separation for other value is not precluded. |  | Yes | N/A | UE does not support frequency separation class for inter-band CA with CBM.  | Per BC | No | FR2 only | N/A |  | Optional with capability signalling |

Option 2 (LGE, R4-2204687)

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| NR\_RF\_FR2\_req\_enh2 | X-x | Frequency separation class for inter-band DL CA based CBM | Capability to indicate frequency separation between lower edge of lowest CC and upper edge of highest CC in CA combination band for inter-band DL CA based on CBM. The UE indicating this capability shall meet the corresponding UE requirements defined in Section TBD.  |   | yes | no | UE does not support inter-band DL CA with corresponding UE requirements defined in Section TBD. | Per BC | No | FR2 only |  |  | Optional with capability signalling |

**Recommended WF:**

**TBA**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Apple** | We are still not in favor of introducing the Fs\_Inter for CBM inter-band CA and would like to continue the discussion in thread 125. |
| **Huawei 2** | Support introducing this capability. Discussion on the detail is in thread [125] |

**Issue 17-4: Others for FR2 enhancement (R4-2206051, Nokia)**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| DC-location | 2-5 | Support of UL DC location(s) report | Capability of support for the extended DC location reporting (based on indicated default DC location) for at least 2 UL CCs. |  | yes | no | UE does not support the Rel-17 extended UL DC location reporting | Per band per BC | No | No |  |  | Optional with capability signalling |
| New CA BW clases | 2-6 | Support of new CA BW Classes | RAN4 has introduced new CA BW Classes ‘R, S, T, U’ for REL17 |  | yes | no | UE does not support the Rel-17 extended FBG2 bandwidths | per band | No | FR2 only |  |  | Optional with capability signalling |
| [FBG 3+2] | 2-7 | [Support of new CA BW Classes] | RAN4 may introduce new fall back group and or new CA BW classes under FBG3+2 discussion |  | yes | no |  | per band | No | FR2 only |  |  | Optional with capability signalling |

**Recommended WF:**

**TBA**

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| --- | --- |
| **Company** | **Comments** |
| **Apple** | Related to DC location:In our understanding, RAN2 already has defined a framework for the UE to indicate the various DC location scenarios based on the previously sent RAN4 LS. Our further proposal in [R4-2203698] is as follows: to support the reporting of multiple DC locations, the signaling should allow the UE to indicate multiple frequency blocks where DC would reside. In our understanding, this capability indication just lets the network know that it supports the Rel-17 features, but further technical discussion still needs to converge in thread 127, and a further LS to RAN2 might also be necessary. |
| **Huawei 2** | Technical discussion in in thread [127] |

## 17.1 Summary for 1st round

**Issue 17-1: UE features for UL gap for Tx power management (R4-2203809, Apple)**

**Recommended WF: Continue to discuss in email thread#126 in 2nd round**

**Issue 17-2: UE features for UL gap for coherent UL MIMO (R4-2203809, Apple)**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| UL gap for coherent UL MIMO  | [17-2] | Support of UL gap for coherent UL MIMO  | Capability of performing coherent UL MIMO calibration in UL gap  |  | yes | no | UE does not support UL gap for coherent UL MIMO calibration  | ~~FFS per band or~~ per UE | FR2 only  | No | No |  | Optional with capability signalling |

**Recommended WF:**

**This feature was captured in the UE feature list with [] in last meeting. There is no consensus to remove the [].**

**Apple proposes it is per UE capability. Can we update the type as “per UE” and keep this feature group in []?**

**Issue 17-3: Support of Fs\_Inter for CBM inter-band CA**

**Recommended WF: Continue to discuss in email thread#125 in 2nd round.**

**Issue 17-4: Others for FR2 enhancement (R4-2206051, Nokia)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| DC-location | 2-5 | Support of UL DC location(s) report | Capability of support for the extended DC location reporting (based on indicated default DC location) for at least 2 UL CCs. |  | yes | no | UE does not support the Rel-17 extended UL DC location reporting | Per band per BC | No | No |  |  | Optional with capability signalling |
| New CA BW clases | 2-6 | Support of new CA BW Classes | RAN4 has introduced new CA BW Classes ‘R, S, T, U’ for REL17 |  | yes | no | UE does not support the Rel-17 extended FBG2 bandwidths | per band | No | FR2 only |  |  | Optional with capability signalling |
| [FBG 3+2] | 2-7 | [Support of new CA BW Classes] | RAN4 may introduce new fall back group and or new CA BW classes under FBG3+2 discussion |  | yes | no |  | per band | No | FR2 only |  |  | Optional with capability signalling |

**Recommended WF: Continue to discuss in email thread#127 in 2nd round.**

1. NR\_HST\_FR1\_enh

**Issue 18-1: FR1 HST demod (R4-2204428, Intel)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** | **Applicable to the capability signalling exchange between UEs (V2X WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 18-4 | Support of enhanced Demodulation requirements for CA in HST SFN FR1 | 1) Support of demodulation processing for HST SFN CA scenario in FR1 | Rel-16 RAN4 feature 10-2 | Yes | No | UE is not able to apply demodulation processing for HST SFN CA scenario in FR1 | Per FSPC | No | FR1 only | N/A |  | Optional with capability signalling |

**Recommended WF:**

**Discuss in demod session**

## 18.1 Summary for 1st round

**Issue 18-1: FR1 HST demod (R4-2204428, Intel)**

**GTW agreement in Demod session: per band combination**

**Recommended WF: The GTW agreements will be captured in the UE feature list.**

1. NR\_MG\_enh

**Issue 19-1: UE feature list for pre-MG**

In last RAN4 meeting, there were agreements in the WF (R4-2202614) to introduce the UE features, as captured below:

Introduce separate UE capabilities of network-controlled and UE autonomous mechanism for preconfigured measurement gap activation and deactivation.s

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Feature group** | **Components** | **Consequence if the feature is not supported by the UE** | **Note** | **Mandatory/Optional** |
| X-1-1 | Pre-configured measurement gap with network-controlled activation and deactivation mechanism  | UE does not support pre-configured measurement gap with Network-controlled mechanism |  | Optional with capability signalling |
| X-1-2 | Pre-configured measurement gap with UE autonomous activation and deactivation mechanism  | UE does not support pre-configured measurement gap with UE autonomous mechanism |  | Optional with capability signalling |

**Recommended WF: Capture the following features for pre-configured gap in feature list**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 19-3-1 | Pre-configured measurement gap with network-controlled activation and deactivation mechanism  | Capability of supporting preconfigured measurement gap with network-controlled mechanism for activation and deactivation |  | yes | no | UE does not support pre-configured measurement gap with Network-controlled mechanism | per UE | No | No |  |  | Optional with capability signalling |
| 19-3-2 | Pre-configured measurement gap with UE autonomous activation and deactivation mechanism  | Capability of supporting preconfigured measurement gap with UE autonomous mechanism for activation and deactivation |  | yes | no | UE does not support pre-configured measurement gap with UE autonomous mechanism | per UE | No | No |  |  | Optional with capability signalling |

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Apple** | We support capturing the agreed pre-MG capabilities in the feature list. We think one UE capability would be sufficient, in which a UE can report it supports:1. Support of NW-controlled pre-configured MG activation/deactivation only
2. Support of UE autonomous pre-configured MG activation/deactivation only
3. Support both 1) and 2)
 |
| **MTK** | We do not really see a big difference between the RRM session agreement and Apple’s proposal. To save some time, we would suggest to just follow the RRM session agreements. |
| **Intel** | The intention is not to indicate to RAN2 explicitly how many capability elements is needed. The detailed design is up to RAN2. |

**Issue 19-2: UE feature list for concurrent gap and NCSG**

|  |  |  |
| --- | --- | --- |
| [**R4-2203809**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203809.zip) | Further discussion on R17 feature list | Apple |
| [**R4-2203851**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203851.zip) | A new Rel-17 per-FR MG capability based on Per BC | Qualcomm Incorporated |
| [**R4-2204054**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204054.zip) | Inputs to Rel-17 NR UE features for measurement gap enhancement and UE power saving enhancement | MediaTek inc. |

The above Tdocs discuss the concurrent gap and NCSG features, since more discussion are needed, suggest discussing in RRM session and capture the output in feature list

**Recommended WF:**

**Discuss in RRM session**

## 19.1 Summary for 1st round

**Issue 19-1: UE feature list for pre-MG**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 19-3-1 | Pre-configured measurement gap with network-controlled activation and deactivation mechanism  | Capability of supporting preconfigured measurement gap with network-controlled mechanism for activation and deactivation |  | yes | no | UE does not support pre-configured measurement gap with Network-controlled mechanism | per UE | No | No |  |  | Optional with capability signalling |
| 19-3-2 | Pre-configured measurement gap with UE autonomous activation and deactivation mechanism  | Capability of supporting preconfigured measurement gap with UE autonomous mechanism for activation and deactivation |  | yes | no | UE does not support pre-configured measurement gap with UE autonomous mechanism | per UE | No | No |  |  | Optional with capability signalling |

**Recommended WF:**

**The above features were agreed in RRM session last meeting, capture the feature groups in UE feature list.**

**Issue 19-2: UE feature list for concurrent gap and NCSG**

**Recommended WF: Continue to discuss in email thread#217 and 219 in RRM session**

1. NR\_PC2\_UE\_FDD

Proposal (Apple, R4-2203809)

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| HPUE FDD | X-1 | Hybrid duplex operation | Support of hybrid duplex operation | N/A | Yes | No | UE does not support hybrid duplex operation | Per Band | FDD only | FR1 only | N/A |  | Optional with capability signalling |

We propose to introduce a new UE capability of supporting hybrid duplex operation for PC2 FDD bands. It can indicate to the need to configure UE to half-duplex mode or back to full-duplex mode as needed. The mode configuration can potentially be done semi-statically through RRC reconfiguration or dynamically through MAC-CE process.

Proposal (China Unicom, R4-2204203)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| HPUE FDD | X-2 | MSD reduction | Support of reducing UE Tx power for certain bandwidth in specific bands, where the reference sensitivity degradation is larger than or equal to [3]dB under power class 2 operation. | N/A | Yes | No | UE does not support lowering the MSD by reducing UE Tx power | Per Band | FDD only | FR1 only | N/A | Network can configure whether to enable the UE capability | Optional with capability signalling |

**Recommended WF:**

**TBA**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | X-1 is still under discussion in our understanding, should not be discussed here. |
| Skyworks | For X-2 we do not think there is an agreement on this yet. MSD can also be reduced by scheduling more appropriate UL configurations. |
| **Apple** | For Hybrid duplex operation:We suggest expanding the capability to have two components:Component 1: Whether the UE supports hybrid duplex operationComponent 2: Switching threshold associated with hybrid duplex capability, where the value is CBW-dependent, like PHR (value in dB)Component 3: Whether the UE needs to receive a network configuration to indicate that there is a mode change in hybrid duplex operationFor MSD reduction:We can accept this proposed capability as a package together with the hybrid duplex operation capability, as described above |
| **Huawei 2** | X-1 might have RAN1 impact, which is not favored by us.Support X-2. |

## 21.1 Summary for 1st round

**Recommended WF: Continue to discuss in email thread#119 in 2nd round**

1. NR\_UE\_pow\_sav\_enh

**Issue 22-1: Feature for RLM/BFD relaxation (power saving)**

In last meeting, RAN4 agreed to introduce a UE capability for supporting RLM/BFD relaxation [5].

|  |
| --- |
| ***Issue 1-1-1: Feature for RLM/BFD relaxation in Rel-17 feature table**** *RAN4 to introduce a UE capability to indicate the support of RLM/BFD relaxation in general in Rel-17 feature table.*
 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type** | Need of FDD/TDD diff. | Need of FR1/FR2 diff. | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/ Optional |
| Y. NR\_UE\_pow\_sav\_enh | Y-1 | RLM/BFD relaxation  | Capability of supporting RLM/BFD relaxation in CONNECTED mode |  | yes | no | UE does not support RLM/BFD relaxation | per UE | No | No |  |  | Optional with capability signalling |

**Recommended WF: discuss in RRM session**

## 21.1 Summary for 1st round

**Recommended WF: RRM session will discuss this on Friday GTW, feature list can be updated based on the outcome.**

1. Open issues

**Issue 23-1: Per BC indication for the per-FR gap capability**

Proposal (R4-2203851)

Keep the original per UE per-FR gap indication and add new Per BC indication for the per-FR gap capacity to Rel-17 UE feature list.

**Recommended WF:**

**This issue had been discussed in last meeting. No consensus was reached.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Apple** | As commented at the last meeting, we would like to understand what constraint a UE might face in terms of baseband processing capability. Some concrete examples shared by proponents are appreciated. |

**Issue 23-2: TXD**

|  |
| --- |
| **Discussion in last meeting****Issue 4-1: TxD support per band per band combination****Issue 4-2: New power class signalling per band per band combination**Continue to discuss how to solve the ambiguity of per-band power class for PC2 CA/DC in 2nd round.Option 1(Apple): indicate TxD support per band per band combinationOption 2 (MediaTek, Huawei, Ericsson): indicate new power class per band per band combinationOther options are not precluded.**Recommended WF:**More companies prefer to consider option 2 to solve the issue. And some companies believe these two issues can be discussed separately. Continue to discuss in next meeting. |

Option 1 (R4-2203809 Apple)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| TxD | X-1 | TxD support per band per band combination | TxD support per band | Yes | No | UE uses a single Tx  | Per FSPC (per CC per band per BC) | No | FR1 only | N/A |  | Optional with capability signalling |

- New signaling was agreed to be introduced in Rel-17, and RAN2 has introduced a per-band optional capability with a restriction to FR1 only

- In the case of a UE supporting TxD in a particular band within a band combination, we should consider the scenario of a UE falling back to single Tx operation (i.e. in a single carrier configuration the UE supports TxD, but when used with inter-band CA the UE falls back to single Tx); we do have this signaling for EN-DC, but not for inter-band CA; thus, we need an additional per band per band combination capability that indicates that the UE supports TxD in band X applicable to all inter-band UL CA combinations

Option 2 (R4-2204479, MTK)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| TxD | X-1 | TxD support per band per band combination | Support of transmit diversity per band per band combination | TxD support per band | Yes | No | UE uses a single Tx  | Per FSPC (per CC per band per BC) | No | FR1 only | N/A |  | Optional with capability signalling |
|  | X-2 | TxD UE power class per band per band combination | Per band per band combination power class | Per band per band combination power class | Yes | No | Per band power class inconsistent | Per band per BC | No | FR1 only | N/A |  | Optional with capability signalling |

**Recommended WF:**

**Companies please comment whether issue 4-1 and 4-2 should be discuss separately, and your views on feature groups**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Qualcomm** | This feature is introducing a NBC change. UE should be able to maintain its power class in all configurations. This also has implications on the UL MIMO capability, will the UE now also be allowed to change the number of layers it supports in single carrier and CA? |
| **MediaTek** | Option 2. |
| **ZTE** | More discussion required. If a band (“Band A”) can operate in TxD mode in one band combination C (“Band A” + “Band B”), where both PAs are used for Band A at a time, and then in order to transmit over Band B, a switching is required from transmitting Band A in TxD mode. This behavior is similar to Tx switching. We can further check if these two features are associated somehow. |
| **Skyworks** | TxD signaling per band per BC and per band per BC power class may be redundant but the later could be used for the increased power capability. |
| **Apple** | In order to resolve the power class fallback issue for TxD, we agree with introducing TxD support per band per band combinationRegarding the proposed TxD UE power class per band per band combination, we suggest considering a more robust approach, which can be applicable to the general UL CA case. In addition to the TxD support per band per band combination, the network also needs to know the UE's power class capability per band per band combination. If RAN4 agrees to define the "UE power class per band per band combination" capability, then it does not need to be part of the TxD feature group and can be a generic FR1 RF feature. |
| **Huawei 2** | Propose to consider another alternative X-3 which is the same as X-2 with below exception: Feature group is ‘UE power class per band per band combination’. This is similar to the existing signalling ‘powerClassNRPart-r16’.X-1 is not needed as there would be no ambiguity when power class per band per BC is reported. |

**Issue 22-3: Power\_Limit\_CA\_DC**

Proposal (Huawei, R4-2205191):

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** | **Applicable to the capability signalling exchange between UEs (V2X WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 22. Power\_Limit\_CA\_DC | 22-1 | NR UL CA/DC | Indicates the power class per-band and the max total output power when operating according to this band combination. |  | Yes | No | UE cannot fully utilize its Tx power capability for a band combination | Per BC | No need | FR1 only | N/A |  | Optional with capability signalling |

**Recommended WF:**

**TB**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Qualcomm** | This capability has nothing to do with the increase of maximum output power. The proposal seems to be to allow the UE to change its UL power in the same band depending on the CA combination. This is also NBC since old base station would not understand this signaling. |
| **Apple** | This would depend upon the outcome of the power limit CA/DC discussion in thread 118. |
| **Huawei 2** | Technical discussion is in thread [118] |

**Issue 22-4: NR\_IIOT\_URLLC\_enh (R4-2203657, Nokia)**

Proposal: RAN4 does not introduce additional UE feature group for Rel-17 IIOT/URLLC.

**Recommended WF:**

**RAN4 does not introduce additional UE feature group for Rel-17 IIOT/URLLC.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Apple** | This issue is being discussed on thread#233 issue 3-1. To avoid duplicated discussion, we suggest RAN4 discuss this on thread#233. |
| **Intel** | We support this WF. |

**Issue 22-5: NR\_HST\_FR2 (R4-2204428, Intel)**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | Consequence if the feature is not supported by the UE | Type(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC) | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| x-1 | Support of FR2 HST operation | 1) Support of FR2 UE PC62) Support of enhanced RRM requirements for FR2 HST3) Support of demodulation processing for FR2 HST  | N/A | Yes | No | UE is not able to meet the enhanced requirements in HST FR2 | Per Band | No | Applicable to FR2 only | N/A | FR2 UE power class PC6 signalling is used to indicate support of feature group | Optional with capability signalling |

**Recommended WF:**

**TBA**

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| **Company** | **Comments** |
| **Apple** | In our understanding, an agreement has been reached in the RRM session. |
| **Intel** | We agree that it is already concluded in RRM session. We as the proponent will update the feature list file to include it.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | Consequence if the feature is not supported by the UE | Type | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| x-1 | Support of FR2 HST operation | 1) Support of FR2 UE PC62) Support of enhanced RRM requirements for FR2 HST (except the requirement for one shot large UL timing adjustment)3) Support of demodulation processing for FR2 HST  | [R15 RAN4 feature group:Support of FR2 UE power class 6] | Yes | No | UE does not meet FR2 high speed train scenario | Per Band | No | Applicable to FR2 only | N/A | FR2 UE power class PC6 signalling is used to indicate support of feature group | Optional with capability signaling |

 |

## 23.1 Summary for 1st round

**Issue 23-1: Per BC indication for the per-FR gap capability**

Proposal (R4-2203851)

Keep the original per UE per-FR gap indication and add new Per BC indication for the per-FR gap capacity to Rel-17 UE feature list.

**Recommended WF: No consensus to define this feature. Continue to discuss in 2nd round**

**Issue 23-2: TXD**

Option 1 (R4-2203809 Apple)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| TxD | X-1 | TxD support per band per band combination | TxD support per band | Yes | No | UE uses a single Tx  | Per FSPC (per CC per band per BC) | No | FR1 only | N/A |  | Optional with capability signalling |

- New signaling was agreed to be introduced in Rel-17, and RAN2 has introduced a per-band optional capability with a restriction to FR1 only

- In the case of a UE supporting TxD in a particular band within a band combination, we should consider the scenario of a UE falling back to single Tx operation (i.e. in a single carrier configuration the UE supports TxD, but when used with inter-band CA the UE falls back to single Tx); we do have this signaling for EN-DC, but not for inter-band CA; thus, we need an additional per band per band combination capability that indicates that the UE supports TxD in band X applicable to all inter-band UL CA combinations

Option 2 (R4-2204479, MTK)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| TxD | X-1 | TxD support per band per band combination | Support of transmit diversity per band per band combination | TxD support per band | Yes | No | UE uses a single Tx  | Per FSPC (per CC per band per BC) | No | FR1 only | N/A |  | Optional with capability signalling |
|  | X-2 | TxD UE power class per band per band combination | Per band per band combination power class | Per band per band combination power class | Yes | No | Per band power class inconsistent | Per band per BC | No | FR1 only | N/A |  | Optional with capability signalling |

New Option 3 (Huawei): consider another alternative X-3 which is the same as X-2 with below exception:

Feature group is ‘UE power class per band per band combination’. This is similar to the existing signalling ‘powerClassNRPart-r16’.

**Recommended WF: Discuss on Friday GTW session**

**Issue 22-3: Power\_Limit\_CA\_DC**

**Recommended WF: Continue to discuss in email thread#118**

**Issue 22-4: NR\_IIOT\_URLLC\_enh (R4-2203657, Nokia)**

**Recommended WF: Follow RRM session agreements.**

**Issue 22-5: NR\_HST\_FR2 (R4-2204428, Intel)**

**Recommended WF:**

**RRM GTW agreements are:**

* + The following UE feature list description for feature “x-1 Support of FR2 HST operation” is endorsed in the RRM session. Further confirmation in the RAN4 Main and Demod session is required.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | Consequence if the feature is not supported by the UE | Type | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| x-1 | Support of FR2 HST operation | 1) Support of FR2 UE PC62) Support of enhanced RRM requirements for FR2 HST (except the requirement for one shot large UL timing adjustment)3) Support of demodulation processing for FR2 HST  | [R15 RAN4 feature group:Support of FR2 UE power class 6] | Yes | No | UE does not meet FR2 high speed train scenario | Per Band | No | Applicable to FR2 only | N/A | FR2 UE power class PC6 signalling is used to indicate support of feature group | Optional with capability signaling |

## 23.2 2nd round discussion

**Issue 23-1: Per BC indication for the per-FR gap capability**

Proposal (R4-2203851)

Keep the original per UE per-FR gap indication and add new Per BC indication for the per-FR gap capacity to Rel-17 UE feature list.

**Recommended WF: Continue to discuss in 2nd round**

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| **Company** | **Comments** |
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**Issue 23-2: TXD**

Option 1 (R4-2203809 Apple)

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| TxD | X-1 | TxD support per band per band combination | TxD support per band | Yes | No | UE uses a single Tx  | Per FSPC (per CC per band per BC) | No | FR1 only | N/A |  | Optional with capability signalling |

- New signaling was agreed to be introduced in Rel-17, and RAN2 has introduced a per-band optional capability with a restriction to FR1 only

- In the case of a UE supporting TxD in a particular band within a band combination, we should consider the scenario of a UE falling back to single Tx operation (i.e. in a single carrier configuration the UE supports TxD, but when used with inter-band CA the UE falls back to single Tx); we do have this signaling for EN-DC, but not for inter-band CA; thus, we need an additional per band per band combination capability that indicates that the UE supports TxD in band X applicable to all inter-band UL CA combinations

Option 2 (R4-2204479, MTK)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| TxD | X-1 | TxD support per band per band combination | Support of transmit diversity per band per band combination | TxD support per band | Yes | No | UE uses a single Tx  | Per FSPC (per CC per band per BC) | No | FR1 only | N/A |  | Optional with capability signalling |
|  | X-2 | TxD UE power class per band per band combination | Per band per band combination power class | Per band per band combination power class | Yes | No | Per band power class inconsistent | Per band per BC | No | FR1 only | N/A |  | Optional with capability signalling |

Option 3 (Huawei): consider another alternative X-3 which is the same as X-2 with below exception:

Feature group is ‘UE power class per band per band combination’. This is similar to the existing signalling ‘powerClassNRPart-r16’.

**Recommended WF: Continue to discuss in 2nd round**

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| **Company** | **Comments** |
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# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| **Rel-17 UE feature list** | **CMCC** |  |
| **LS on Rel-17 RAN4 UE feature list for NR** | **CMCC** |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| [**R4-2203657**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203657.zip) | UE features for enhanced IIoT and URLLC | Nokia | **Noted** |  |
| [**R4-2203809**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203809.zip) | Further discussion on R17 feature list | Apple | **Noted** |  |
| [**R4-2203851**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203851.zip) | A new Rel-17 per-FR MG capability based on Per BC | Qualcomm Incorporated | **Noted** |  |
| [**R4-2204054**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204054.zip) | Inputs to Rel-17 NR UE features for measurement gap enhancement and UE power saving enhancement | MediaTek inc. | **Noted** |  |
| [**R4-2204428**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204428.zip) | Discussion on Rel-17 RAN4 UE feature list | Intel Corporation | **Noted** |  |
| [**R4-2204479**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204479.zip) | Continue discussion on capability signaling for HPUE NR DC | MediaTek Inc. | **Noted** |  |
| [**R4-2204484**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204484.zip) | draft LS to RAN2 for NR CA\_DC power class | MediaTek Inc. | **Noted** |  |
| [**R4-2204651**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204651.zip) | Update on Rel-17 RAN4 UE feature list for NR | vivo | **Noted** |  |
| [**R4-2204687**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204687.zip) | Discussion on Fs\_inter for FR2-1 inter-band DL CA based on CBM within same frequency group | LG Electronics | **Noted** |  |
| [**R4-2205191**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205191.zip) | On Rel-17 feature list | Huawei, HiSilicon | **Noted** |  |
| [**R4-2206051**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206051.zip) | On rel-17 UE features | Nokia, Nokia Shanghai Bell | **Noted** |  |
| [**R4-2206098**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206098.zip) | R17 UE feature list proposal | Qualcomm communications-France | **Noted** |  |

Notes:

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

##  2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
|  |  |  |  |  |

Notes:

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

# Annex

Contact information

|  |  |  |
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Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)