**3GPP TSG-RAN WG2 Meeting #116 electronic R2-21xxxxxx**

**Online, Nov 1-12, 2021**

**Agenda item:** 8.24.1

**Source:** Huawei, HiSilicon

**Title:** Summary of [AT116-e] [025][NR17] UL TX Switching & 100M BW (Huawei)

**Document for:** Discussion and Decision

# 1. Introduction

This document attempts to summarize the following offline discussion.

* [AT116-e][025][NR17] UL TX Switching & 100M BW (Huawei)

Scope: Treat R2-2111059, R2-2111060, R2-2111061, R2-2110424, R2-2110974

Determine agreeable parts, Identify discussion points for online (if needed).

Intended outcome: Ph1 Report, Ph2 if applicable: endorsed CRs.

Deadline: Friday W1 (CB online if needed)

Rapporteur suggests companies to provide comments before Thursday W1 UTC 10:00, so that the agreeable part/possible way forwards can be summarized before on-line CB Friday W1.

# 2. Contact info

|  |  |  |
| --- | --- | --- |
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| Qualcomm Incorporated | Masato Kitazoe | mkitazoe@qti.qualcomm.com |
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# 3. Phase 1 discussion

## 3.1 UL Tx switching

In previous RAN2 meetings, the UE capability reporting has been discussed and according to RAN2 agreements and common understanding, the running CRs to TS 38.331 and TS 38.306 on UE capability reporting were endorsed in R2-2109225 and R2-2109226 in RAN2 #115 meeting. However, RAN2 did not go deep into the RRC configuration part as some related aspects were under-discussion in RAN1.

In R2-2111059 explained that in RAN1 Oct meeting RAN1 made some progress related to the RRC configuration, i.e.:

* RAN1 agreed to introduce a new RRC parameter to configure switching state for inter-band CA 2T-2T switching option2.
* RAN1 has not achieved conclusion on how to enable UE/NW have aligned understanding on which switching mode (i.e. 1T-2T switching or 2T-2T switching) to be used, e.g. via new RRC configuration or existing RRC parameters.

Then R2-2111059 propose to capture the new RRC parameter into the RRC running CR. With regard to 2T-2T switching, R2-2111059 propose to continue waiting for RAN1 conclusion.

Meanwhile, for 1T-2T switching with 2CCs configured in Band B, as RAN1 agreed the existing Rel-16 1T-2T switching mechanism is reused, R2-2111059 propose RAN2 start to discuss this case and propose to reuse the existing Rel-16 parameters to indicate the switching period location and carrier role.

Companies are welcome to give comments on the 4 proposes within R2-2111059.

Proposal 1: RAN2 to capture the RRC parameter to configure the state of Tx chains for UL-CA option2 in case of 2Tx-2Tx switching.

Proposal 2: RAN2 to wait for RAN1 further progress on whether to reuse existing RRC parameter or introduce a new RRC parameter for UE differentiation 1Tx-2Tx switching and 2Tx-2Tx switching.

Proposal 3: To configure 2CCs on band B for 1Tx-2Tx switching, among the 3 uplinks configured with UplinkTxSwitching, the field uplinkTxSwitchingPeriodLocation is configured to either the uplink on band A or both uplinks on band B (i.e. the band capable of 2Tx).

Proposal 4: To configure 2CCs on band B for 1Tx-2Tx switching, among the 3 uplinks configured with UplinkTxSwitching, the field uplinkTxSwitchingCarrier is set as carrier1 for the uplink on band A, while the field uplinkTxSwitchingCarrier is set as carrier2 for the both uplinks on band B (i.e. the band capable of 2Tx).

**Q1-1: Do companies agree P1 within** **R2-2111059 as it is: RAN2 to capture the RRC parameter to configure the state of Tx chains for UL-CA option2 in case of 2Tx-2Tx switching?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm Incorporated | No | We appreciate the effort from the proponents updating RAN2 for RAN1 progress. We however do not think it is a good idea to continue this process requiring RAN2 to figure out what is going on in RAN1. RAN2 should act based on official input from RAN1. |
| Ericsson |  | We are fine with Qualcomm’s suggestion to wait for official input from RAN1. |
| OPPO |  | We are fine with Qualcomm’s suggestion to wait for official input from RAN1. |
| China Telecom | Yes | We think RAN1 agreement that introducing a new RRC parameter to configure switching state for inter-band CA 2T-2T switching option2 is stable. And the corresponding RRC configuration seems simple and straightforward, so we can discuss it in RAN2. |
| Huawei, HiSilicon | Yes | Usually RAN2 can discuss RAN2 spec impact based on RAN1 agreements, especially for RRC configuration which is in the RAN2 scope. As this RAN1 agreement is quite clear and straightforward, we do not see the need to wait for more RAN1 input, so suggest companies could check this RRC signalling design. |
| vivo |  | We agree with Qualcomm to wait for further RAN1 input. |
| MediaTek |  | We also agree with Qualcomm |
| Nokia, Nokia Shanghai Bell | No | Agree with Qualcomm: We should wait for RAN1 |
| Apple | Wait for RAN1 |  |
| CATT | Yes |  |

**Q1-2: Do companies agree P2 within R2-2111059 as it is: RAN2 to wait for RAN1 further progress on whether to reuse existing RRC parameter or introduce a new RRC parameter for UE differentiation 1Tx-2Tx switching and 2Tx-2Tx switching?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm Incorporated | No | We appreciate the effort from the proponents updating RAN2 for RAN1 progress. We however do not think it is a good idea to continue this process requiring RAN2 to figure out what is going on in RAN1. RAN2 should act based on official input from RAN1. |
| Ericsson | Yes | This should be in line with Qualcomm’s suggestion on wait for official input from RAN1. |
| OPPO |  | wait for official input from RAN1. |
| China Telecom | Yes | Regarding whether to reuse existing RRC parameter or introduce a new RRC parameter for UE differentiation 1Tx-2Tx switching and 2Tx-2Tx switching, we agree to wait for RAN1 progress. |
| Huawei, HiSilicon | Yes |  |
| vivo |  | We agree with Qualcomm to wait for further RAN1 input. |
| MediaTek | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes | We agree with Qualcomm to wait for RAN1 input. |
| Apple | Wait for RAN1 |  |
| CATT | Yes |  |

**Q1-3: Do companies agree P3 within R2-2111059 as it is: To configure 2CCs on band B for 1Tx-2Tx switching, among the 3 uplinks configured with UplinkTxSwitching, the field uplinkTxSwitchingPeriodLocation is configured to either the uplink on band A or both uplinks on band B (i.e. the band capable of 2Tx)?**

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| Company | Yes/No | Comments |
| Qualcomm Incorporated | No | We appreciate the effort from the proponents updating RAN2 for RAN1 progress. We however do not think it is a good idea to continue this process requiring RAN2 to figure out what is going on in RAN1. RAN2 should act based on official input from RAN1. |
| Ericsson |  | We are fine with Qualcomm’s suggestion to wait for official input from RAN1. |
| OPPO |  | wait for official input from RAN1. |
| China Telecom | Yes | For the scenarios 2CCs on band B in case of 1Tx-2Tx switching, RAN1 and RAN4 agreed the same UE behaviour of Rel-16 1Tx-2Tx, so we think RAN2 can discuss whether and how the existing signalling is applicable to the case of 2CCs on bandB. |
| HiSilicon | Yes | We share the same view as China Telecom. We understand in terms of RAN4 requirements and RAN1 L1 mechanisms, there is no difference between Rel-16 1T-2T switching with 2 uplinks and Rel-17 1T-2T switching with 3 uplinks, so it seems no input will be from either RAN1 or RAN4 on it.  Then we need to make it clear whether the same signalling can be/prefer to be reused in RAN2. Note that the carrier role is introduced by RAN2 self, based on no RAN4/RAN1 request in Rel-16. |
| vivo |  | We agree with Qualcomm to wait for further RAN1 input. |
| MediaTek |  | We agree with Qualcomm to wait for further RAN1 input. |
| Nokia, Nokia Shanghai Bell |  | Same as others, we agree with Qualcomm to wait for further RAN1 input. |
| Apple | Wait for RAN1 |  |

**Q1-4: Do companies agree P4 within R2-2111059 as it is: To configure 2CCs on band B for 1Tx-2Tx switching, among the 3 uplinks configured with UplinkTxSwitching, the field uplinkTxSwitchingCarrier is set as carrier1 for the uplink on band A, while the field uplinkTxSwitchingCarrier is set as carrier2 for the both uplinks on band B (i.e. the band capable of 2Tx)?**

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| Company | Yes/No | Comments |
| Qualcomm Incorporated | No | We appreciate the effort from the proponents updating RAN2 for RAN1 progress. We however do not think it is a good idea to continue this process requiring RAN2 to figure out what is going on in RAN1. RAN2 should act based on official input from RAN1. |
| Ericsson |  | We are fine with Qualcomm’s suggestion to wait for official input from RAN1. |
| OPPO |  | wait for official input from RAN1. |
| China Telecom | Yes | For the scenarios 2CCs on band B in case of 1Tx-2Tx switching, RAN1 and RAN4 agreed the same UE behaviour of Rel-16 1Tx-2Tx, so we think RAN2 can discuss whether and how the existing signalling is applicable to the case of 2CCs on bandB. |
| Huawei, HiSilicon | Yes | The carrier role is introduced by RAN2 in Rel-16, no RAN4/RAN1 request. Thus it should be decided by RAN2 as well in Rel-17. |
| vivo |  | We agree with Qualcomm to wait for further RAN1 input. |
| MediaTek |  | We agree with Qualcomm to wait for further RAN1 input. |
| Nokia, Nokia Shanghai Bell |  | Same as others, we agree with Qualcomm to wait for further RAN1 input. |
| Apple | Wait for RAN1 |  |

Moderator understand the R2-2111061 and R2-2110424 are resubmissions of the endorsed running CR ported on the latest version of TS 38.331 and TS 38.306. If companies have any concerns on either contribution, please comment in below table.

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| Company | Comments |
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**Phase I summary on UL Tx switching:**

* About Q1-1: 7/10 companies prefer to wait for RAN1, 3/10 companies support to capture this parameter in RRC as RAN1 made a clear agreement to introduce this new RRC configuration in RAN1# 106bis emeeting. The moderator understand there is no big difference between capturing it now or after based on RAN1 RRC parameter list, thus agree to follow majority view.
* About Q1-2: All companies agree the proposal to wait for RAN1 further conclusion on the configuration for 2T-2T switching.

As there is no RAN2 actions are needed for now, no proposals are given for Q1-1 and Q1-2.

* About Q1-3 and Q1-4, 7/9 companies prefer to wait for RAN1, 2/9 companies point out RAN1/RAN2 already agree the Rel-17 1T-2T switching with 2CCs configured on band B will reuse Rel-16 1T-2T switching agreements/mechanism, and there is no pending discussion about Rel-17 1T-2T switching in either RAN1 or RAN4. Moderator understand 2T-2T switching and 1T-2T switching with 2CCs on band B are independent discussion, thus suggest to continue the offline discussion on original P3/P4 unless the companies suggesting to wait for RAN1 can clarify which detailed aspects are pending for RAN1.

**Proposal 1: Continue to discuss the RRC configuration for Rel-17 1T-2T switching with 2CCs on Band B in Phase II. Companies can clarify which detailed aspects are pending for RAN1.**

## 3.2 100M BW

In RAN2#115 meeting, the newly introduced capability for 100M bandwidth for band n40 was discussed and the CRs for Rel-15/Rel-16 were agreed. However, how to handle the capability for 100M bandwidth in Rel-17 is not clear and postponed.

Regarding the two available options on table, R2-2110974 propose to support a consistent handling of the capability bit for 100MHz as Rel-15/Rel-16 for Rel-17, i.e. option2.

* Option 1: The UE shall set it to be 1 if 100MHz bandwidth is mandatory according to TS 38.101-1. (The 100MHz includes the existing 100MHz for bands n41, n48, n77, n78, n79 and n90 and introduced new 100MHz). **It means, the handling of the capability bit for 100MHz is different between Rel-15/Rel-16 and Rel-17.**
* Option 2: The UE shall set it to be 1 if 100MHz bandwidth is required to be mandatory from or after TS 38.101-1 v17.2.0. (The 100MHz only includes introduced new 100MHz). **It means, the handling of the capability bit for 100MHz is the same between Rel-15/Rel-16 and Rel-17.**

**Q2-1: Do companies agree P1 within R2-2110974 as it is: support a consistent handling of the capability bit for 100MHz as Rel-15/Rel-16 for Rel-17?**

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| Company | Yes/No | Comments |
| Qualcomm Incorporated | ? | First of all,  The current text below seems to indicate that the 100MHz bit (the fourth bit) does not have any meaning in case of the listed non-applicable bands.   * The fourth leftmost bit (for 100MHz) is not applicable for bands n41, n48, n77, n78, n79 and n90 as defined in TS 38.101-1 [2]   So if for example 70MHz is made applicable to n41 in the future and the UE signals channelBWs-DL-v1590, the fourth bit can be of any value, but does not indicate anything.  After that, we are not sure if we need to further deal with 100MHz specifically in more detail. We think the standard can simply say that the UE shall set a bit for mandatory channel BW to 1. As a general comment, we think RAN2 failed in handling of the channel BW capabilities by trying to specify too much for RAN4’s requirement, which however is moving target. |
| Ericsson | Yes | The Rel-17 specification should use the exact same field description as agreed for Rel-15/16. This means that if 100 MHz is introduced for any other (existing or new) band than n41, n48, n77, n78, n79 or n90, a UE supporting such band shall use the “100 MHz bit” to indicate explicitly whether it supports this channel bandwidth.  This is aligned with how we always strive to maintain the consistency of UE capability parameters across releases (and the reason why we proposed the existing text on 100MHZ).  In response to Qualcomm comment, we acknowledge that RAN4 requirements are a moving target. It was a mistake that RAN2 did not introduce a “100 MHz” bit in the bitmap already in Rel-15. Omitting capability signalling to enforce mandatoriness is never a good idea.  Clearly the 100MHz bit will not be set by existing legacy UEs in the field, and hence cannot be used by a network to verify support for those bands where 100MHz was already mandated. By listing them specifically in 38.306 we get a crystal clear spec and never revisit. We avoided to instead refer to certain RAN4 spec version (since moving target…). And we avoided any inter-op problems with UEs setting or not setting the 100MHz bit in case UE would signal channelBWs-DL-v1590 for other reason. |
| OPPO (Zhongda) | Yes with comment | The current option2 is fine for band40. However, it may be not correct for other band when 100MHz is introduced in future release for that band. The basic idea of option2 is that the new capability bit is not applicable for bands whose 100MHz is mandatory from Rel15, but for bands introducing new 100MHz bandwidth. Here is our version of option2: |
| Huawei, HiSilicon | Yes (proponent) | For Qualcomm comment, if we go for option 2, then the fourth bit (for 100MHz) is meaningless for bands n41, n48, n77, n78, n79 and n90. If new bandwidth is introduced in future release, the fifth bit should be used. At lease there is no inter-operability issue if the UE and NW have this aligned understanding. And the legacy NW has already implemented this understanding.  For OPPO comment, I think generally we are aligned, the fourth bit (for 100MHz) is not applicable for bands whose 100MHz is mandatory from Rel-15. However, the updated wording may still misleading as “from or after the Release when 100MHz is introduced”, the “Release” can be Rel-15 and this is not the intention of option 2. I think the main point for option 2 is that the handling for 100MHz for R15/R16 and R17 is consistent, and no further spec change for R17 is needed. So we can generally say “the handling for 100MHz for R15/R16 and R17 is consistent”. |
| vivo | Yes | We think option 2 which handle the issue in Rel-17 as the way it is in Rel-15/16 to achieve consistency. |
| MediaTek | Yes | Option 2 is fine |
| Nokia, Nokia Shanghai Bell | Yes | Agree with Ericsson: We always try to have the same meaning for capability bits across releases. Otherwise there would bne issues with UE/NW inter-operability.  Qualcomm does have a point that the handling of 100 MHz support already went wrong in Rel-15, but unfortunately we have to live with that. Doing changes in Rel-17 would just create problems with legacy networks. |
| Apple | Yes to option-2 | Seems better of the available messy ways. |
| Intel | Yes | We would prefer to keep Rel-17 the same as for Rel-15/16. If Option 1 is the preference, it should have been taken when we made the decision for Rel-15/16. |
| ZTE(Wenting) | Yes to option 2 |  |

**Phase I summary on 100M BW:**

9/10 companies support option2, 1 company provide comments but with no preference. About the comments on the bad handling of 100MHz capability and further clarification on Option 2, some companies clarify that as it went wrong from Rel-15 and we already had a solution, the same way can be reused for Rel-17. Moderator suggests to go with majority view of adopting option2. With this, the handling for 100MHz capability for R15/R16 and R17 is consistent, and no further specification change for Rel-17 is needed.

**Proposal 2: The handling for 100MHz capability for Rel-15/Rel-16 and Rel-17 is consistent, no further specification change for Rel-17 is needed.**

## 3.3 Any others issues?

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# 4. Phase 2 discussion

Following the online-discussion agreement, the phase II discussion will concentrate on 1Tx-2Tx switch case, with the questionnaire about RAN2 RRC configuration and the potential related questions to be asked to RAN1 (if any).

* We attempt to progress the 1 TX to 2TX switch case, if there are unclear points can send LS to R1 with questions.

**Q1-a: Do companies agree to reuse Rel-16 signalling (*UplinkTxSwitching*) to configure 1Tx-2Tx switching with 2CCs on band B, i.e. 3 uplinks configured with *UplinkTxSwitching*?**

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| Company | Yes/No | Comments |
| China Telecom | Yes | For the scenario of 1Tx-2Tx switching with 2 CCs on band B, we think the Rel-16 signalling can be reused since RAN1 and RAN4 have already agreed the same UE behaviour of Rel-16 1Tx-2Tx. Reusing the R16 signalling brings not too much spec impact and only some clarifications are enough. |
| Qualcomm Incorporated |  | We agree this is not entirely clear from the information RAN2 has at this moment, and OK to ask RAN1. |
| Ericsson |  | We think this option may be reasonable, but fine to ask RAN1. |
| Huawei, HiSilicon | Yes | Considering the UE behaviour of handing 1T-2T switching with 1CC on band B or 2CC on band B are basically the same, we see no reason to introduce new signalling. This is also try to avoid some unnecessary reconfiguration e.g. if 2 uplinks are already configured with R16 1T-2T switching, then if one CC can be added to band B, at least the original uplinks do not need reconfiguration. Through the addition of the third uplink (with ***UplinkTxSwitching*** configured), network and UE are aware the 1T-2T switching with 3 uplinks is enabled. |
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**Q1-b: For Q1-a, do companies think there are unclear points which we can ask RAN1?**

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| Company | Comments |
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**Q2-a: If the answer to Q1-a is yes, do companies agree: among the 3 uplinks configured with *UplinkTxSwitching*, the field *uplinkTxSwitchingPeriodLocation* is configured to either the uplink on band A or both uplinks on band B (i.e. the band capable of 2Tx)?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| China Telecom | Yes | As specified in RAN4 endorsed CR for R17 Tx switching[R4-2103236], the switching periods are located in either NR band A or band B. To be aligned with RAN4 agreements, the field *uplinkTxSwitchingPeriodLocation* can be configured to either the uplink on band A or both uplinks on band B to indicate the location of switching periods. |
| Qualcomm Incorporated |  | We agree this is not entirely clear from the information RAN2 has at this moment, and OK to ask RAN1. |
| Ericsson |  | We think this option may be reasonable, but fine to ask RAN1. |
| Huawei, HiSilicon | Yes | If we go with reusing legacy signalling, we only need to make sure the configuration for the 2 uplinks on band B is consistent. |
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**Q2-b: For Q2-a, do companies think there are unclear points which we can ask RAN1?**

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| Company | Comments |
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**Q3-a: If the answer to Q1-a is yes, do companies agree: among the 3 uplinks configured with *UplinkTxSwitching*, the field *uplinkTxSwitchingCarrier* is set as *carrier1* for the uplink on band A, while the field *uplinkTxSwitchingCarrier* is set as *carrier2* for the both uplinks on band B (i.e. the band capable of 2Tx)?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| China Telecom | Yes | We support to reuse the R16 field *uplinkTxSwitchingCarrier* also for R17 1Tx-2Tx switching with 2CCs on Band B. For the 2 uplinks on Band B, the field *uplinkTxSwitchingCarrier* can be both set as carrier2. |
| Qualcomm Incorporated |  | We agree this is not entirely clear from the information RAN2 has at this moment, and OK to ask RAN1. |
| Ericsson |  | We think this option may be reasonable, but fine to ask RAN1. |
| Huawei, HiSilicon | Yes | If we go with reusing legacy signalling, we only need to make sure the configuration for the 2 uplinks on band B is consistent. |
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**Q3-b: For Q3-a, do companies think there are unclear points which we can ask RAN1?**

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| Company | Comments |
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**Q4-a: If the answer to Q1-a is no, do companies think Rel-17 parameters are needed for both of period location and carrier configuration similar as *uplinkTxSwitchingPeriodLocation* and *uplinkTxSwitchingCarrier*?**

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| Company | Yes/No | Comments |
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**Q4-b: For Q4-a, do companies think there are unclear points which we can ask RAN1?**

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| Company | Comments |
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**Q5: Are there any other unclear points which we can ask RAN1?**

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| Company | Comments |
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# 5. Conclusion

Phase I summary and proposal:

**UL Tx switching:**

**Proposal 1: Continue to discuss the RRC configuration for Rel-17 1T-2T switching with 2CCs on Band B in Phase II. Companies can clarify which detailed aspects are pending for RAN1.**

**100M BW**

**Proposal 2: The handling for 100MHz capability for Rel-15/Rel-16 and Rel-17 is consistent, no further specification change for Rel-17 is needed.**

6. References

[R2-2111059](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_116-e\Docs\R2-2111059.zip) RAN2 signalling to support R17 UL Tx switching enhancements Huawei, HiSilicon, China Telecom, Apple discussion Rel-17 NR\_RF\_FR1\_enh

[R2-2111060](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_116-e\Docs\R2-2111060.zip) RRC configuration to support R17 UL Tx switching enhancements Huawei, HiSilicon, China Telecom, Apple draftCR Rel-17 38.331 16.6.0 NR\_RF\_FR1\_enh

[R2-2111061](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_116-e\Docs\R2-2111061.zip) Running CR to TS38.331 to support Tx switching enhancements Huawei, HiSilicon, China Telecom, Apple, CATT draftCR Rel-17 38.331 16.6.0 NR\_RF\_FR1\_enh R2-2109225

[R2-2110424](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_116-e\Docs\R2-2110424.zip) Running CR to TS 38.306 to support Tx switching enhancements China Telecom, Huawei, HiSilicon, Apple, CATT draftCR Rel-17 38.306 16.6.0 B NR\_RF\_FR1\_enh R2-2109226

[R2-2110974](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_116-e\Docs\R2-2110974.zip) Discussion on 100M bandwidth capability for Rel-17 Huawei, HiSilicon discussion Rel-17 NR\_bands\_R17\_BWs