**3GPP TSG- Meeting # *12***

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**Agenda Item:** **6.19.1**

**Source: China Telecom**

**Title:** **Report of [AT110e][026][Other] UL Tx switching (China Telecom)**

**Document for: Discussion and decision**

# Introduction

This report is for email discussion

* [AT110e][026][Other] UL Tx switching (China Telecom)

Scope: Treat R2-2004375, R2-2004328, R2-2005219, R2-2004756, R2-2005220, R2-2005222 (proponents are responsible to explain and drive)

Part 1: Identify agreeable changes. Deadline: June 4, 0700 UTC. (Remaining parts if needed can be revisited on-line).

Part 2: For agreeable parts, continuation to agree CRs. Deadline: June 10, 0700 UTC

The related documents are list as below

[R2-2004375](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_110-e\Docs\R2-2004375.zip) LS on UE capability on DL interruption for UL Tx switching (R4-2005665; contact: Apple) RAN4 LS in Rel-16 NR\_RF\_FR1 To:RAN2 Cc:RAN1

[R2-2004328](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_110-e\Docs\R2-2004328.zip) Reply LS on UE Tx switching period delay and DL interruption (R1-2002960; contact: Apple) RAN1 LS in Rel-16 NR\_RF\_FR1 To:RAN4 Cc:RAN2

[R2-2005219](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_110-e\Docs\R2-2005219.zip) Report of [Post109bis-e][045][R16 Other] UL TX Switching-NR\_FR1 (China Telecom) China Telecommunications discussion

[R2-2004756](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2005_R2_110-e/Docs/R2-2004756.zip) Remaining issues on UL switching Apple, China Telecom discussion Rel-16 NR\_newRAT-Core

[R2-2005220](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2005_R2_110-e/Docs/R2-2005220.zip) 38331CR for UE capability and RRC configuration of supporting UL Tx switching China Telecommunications CR Rel-16 38.331 16.0.0 1659 - B NR\_RF\_FR1

[R2-2005222](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2005_R2_110-e/Docs/R2-2005222.zip) 38306CR for UE capability of supporting UL Tx switching China Telecommunications CR Rel-16 38.306 16.0.0 0328 - B NR\_RF\_FR1

# Discussion

## 2.1 potential agreeable changes

In RAN2#109bis-e meeting the following conclusion for UL TX Switching-NR\_FR1 was achieved via online discussion

* In configuration indicate the UL carrier pair (a carrier on one band and another carrier on the other band) for UL Tx switching.
* In configuration indicate switching period (i.e., UL interruption) in *UplinkConfig*.
* to use UE capability filter for UL Tx switching capability reporting.
* R2 assumes that in configuration, we’d have explicit indicating that which carrier is carrier1, which carrier is carrier2.
* New or existing band combination list, under which the UE capabilities associated with UL Tx switching are reported, decide next meeting

In the email discussion [Post109bis-e][045], most companies had consensus views on the following proposals **Proposal 1-3**. The detailed discussion for the proposals can refer to the report of the discussion [1].

**Proposal 1: to introduce a new band combination list, under which the UE capabilities associated with UL Tx switching are reported.**

**Proposal 2: reporting capability on each UL band pairs per BC that supports UL Tx switching.**

**Proposal 3: introducing a capability reporting DL interruption, which is defined as per band per band combination for each band pair supporting UL Tx switching.**

During the draft CR discussion, a slight tendency is to report the capabilities for switching period and DL interruption (in proposal 3) only for the band pairs with UL Tx switching capability.

For the capability which reports the supported option in UL CA case where UE supports UL Tx switching, the level of the capability was controversial [1]. According to RAN1 updated conclusion, the capability was defined as per BC.

**Proposal 4: introducing a per BC capability which reports the supported option (between option 1 or option 2, as specified in TS 38.214) in UL CA case where UE supports UL Tx switching.**

Q1: can we agree the above proposals Proposal 1-4?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments if there is any |
| Ericsson | Yes | We would prefer reporting capability on a single UL band pair per BC, but we recognize the overwhelming majority and the need to close this. The proposals are acceptable to us. |
| CATT | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes with some clarifications | **P2:** We assume that only those carriers for which UL is simultaneously allowed (i.e.UL+UL or UL+SUL) can be paired here.  **P3:** We are fine with this but just like with single UL, we should note that it’s up to RAN4 on which DL carriers the interruption is allowed for a given UL Tx switching case.  **P4:** As we indicated in the email discussion, using generic names like “option 1” and “option 2” is a bad practice: Yes, those are often used during the discussion but once we define the capabilities, it’s necessary that the options describe the behaviour. That’s why we think using e.g. “switchedUL” (option 1) and “dualUL” (option 2) is more meaningful. |
| MediaTek | Yes | On P4 we agree with Nokia that using a meaning full naming is better. But for proposal itself is fine, we could further discuss the naming in the CR. |
| Huawei | Yes | We agree with the four proposals. We can further work on the CR details, e.g. capability names and descriptions in phase 2 discussion. |
| ZTE | Yes | Regarding the naming of option1 and option2, the suggestion from Nokia looks good to us. |
| OPPO | Yes |  |
| Apple | Yes |  |

For Proposal 4, according to RAN1 updated UE feature in R1-2004970 [5] as below, Proposal 4 is updated as Proposal 4a:

**Proposal 4a: introducing a per BC capability which reports the supported option in inter-band UL CA case and EN-DC case where UE supports UL Tx switching. For inter-band UL CA case, the candidate values set is {option1, option2, both option 1 and option 2}. For EN-DC case, the candidate values set is {option1, option2}.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | **Type** | Note | Mandatory/Optional |
| 22. NR Others | 22-1 | Indicating supported option for UL Tx switching for inter-band UL CA | Indicating supported option for UL Tx switching for inter-band UL CA   * Candidate values set is {option1, option2, both option 1 and option 2} | 6-6 and RAN4 FG 7-1 (Tx switching period between two uplink carriers) | Yes | Per BC | It has been agreed in RAN1 that UE can report support of one of the three candidates {option1, option2, both option1 and option2}. It is up to RAN2 to design the corresponding UE capability signalling. | Signaling of this FG is mandatory conditioned on the support of switching time capability for Tx switching between two uplink carriers in inter-band UL CA band combinations in RAN4 FG 7-1 (i.e. Tx switching period between two uplink carriers) |
| 22. NR Others | 22-2 | Indicating supported option for UL Tx switching for EN-DC | Indicating supported option for UL Tx switching for EN-DC   * Candidate values set is {option1, option2} | EN-DC and RAN4 FG 7-1 (Tx switching period between two uplink carriers) | Yes | Per BC | N/A (FR1 only) | Signaling of this FG is mandatory conditioned on the support of switching time capability for Tx switching between two uplink carriers in EN-DC in RAN4 FG 7-1 (i.e. Tx switching period between two uplink carriers) |

## 2.2 other issues before 110e-online

There were some other issues in the discussion [Post109bis-e][045], some of which we did not have enough time to discuss.

Companies are welcome to provide issues and proposals if the raised issues still remain or there are other new ones. Especially for the issues having potential impact for the CRs, signalling examples for the CRs would be appreciated.

Q2: Do companies have any other issues or proposals? If so, they can be provided below.

|  |  |
| --- | --- |
| Company | Issues/Proposals |
| Ericsson | We think we have to discuss also how to make UE capability coordination between MN and SN for EN-DC/NR-DC cases, since a new band combination list is added and the current signalling for *allowedBC-ListMRDC* cannot signal band combination entries from this new band combination list. Probably something similar as the approach we adopted for *supportedBandCombinationListNEDC-Only* could work. |
| Nokia, Nokia Shanghai Bell | It needs to be made clear in the CR that the so-called “Case 1” functionality only applies when the UL Tx switching is configured: With legacy configuration, UE still behaves according to legacy (i.e. it is capable of UL transmission on both carriers involved in the UL Tx switching as per Rel-15 operation). |
| MediaTek | The CR in general need more detail discussion. We could further work on this once we agree P1 to P4. |
| OPPO | Even though we agreed on the new BC list, it is good to clarify the intended capability to be reported in the legacy BC list and the new BC list, which is not crystal clear yet. |
| Apple | Agree with OPPO that we should clarifty how UE report UE capabilities for legacy BC list and new BC list, which is discussed in our paper R2-2004756. But we could discuss those details in the second phase as long as it does not impact the CR drafting. |

## 2.3 110e-online conclusions and left issues

After the online discussion on 9th June, the following decisions have been achieved:

[026] DISCUSSION and Decisions:

* [026] introduce a new band combination list, under which the UE capabilities associated with UL Tx switching are reported.
* [026] reporting capability on each UL band pairs per BC that supports UL Tx switching.
* Introduce a capability reporting DL interruption, which is defined as per band per band combination for each band pair supporting UL Tx switching (if more info from R4 people can be provided, this can be rediscussed)
* introduce a per BC capability which reports the supported option in inter-band UL CA case and EN-DC case where UE supports UL Tx switching. For inter-band UL CA case, the candidate values set is {option1, option2, both option 1 and option 2}. For EN-DC case, the candidate values set is {option1, option2}.

[R2-2004756](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_110-e\Docs\R2-2004756.zip) DISCUSSION and Decisions:

* In the new BC list, the UE reports a mixed UE capability which exceeds its total Tx number, e.g., 1Tx on carrier 1 and 2 Tx on carrier 2 and relies on NW side to figure out 1Tx+2Tx can only be used in a TDM manner.
* Do not consider the lower order band combination from the parent band combination with UL Tx switching as fallback band combination.
* Confirm that for a parent band combination without UL Tx switching, UE is allowed to report a lower order band combination with UL switching.

There are some issues left as following.:

For Proposal 1 in [R2-2004756](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_110-e\Docs\R2-2004756.zip), Alt1-3 has been agreed as above. The capability reporting for case 1 need further discussion. This discussion can also be related to Nokia’s clarification on case1 and the legacy case in section 2.2.

- Chair: Need to understand how 1TX+1TX will work as well, can be progressed offline.

### Q3: whether to report 1Tx+1Tx (case 1) in the new BC list?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | comments |
| Apple | No strong view  But fine with Yes | First, the key factor is whether NW side would do cross check from legacy container and new container. If Not, seems it is a must to report 1Tx+1Tx in the new BC list.  The second factor is whether UE can report different UE capabilities for case 1 and legacy case (no UL switching at all). If Yes, UE should also report 1Tx+1Tx in the new container.  [Apple 2]: Regarding OPPO’s comment, I tend to agree Alt1-3 somehow mixes case 1 and case 2 capability for two carriers. When the paper was drafted, my understanding is 1+1 Tx UE capability is not needed in the new container.  If eventually RAN2 agree that 1+1 Tx should be also reported in the new container, perhaps Alt 1-2 makes more sense than Alt1-3. |
| OPPO | See comment | As commented online, Alt1-3 is confusing if only 1TX @ carrier-1 is put into new BC list, but without 1TX @ carrier-2: Considering case-1 (when UL switching is configured) requires 1TX capability of both carrier-1 and carrier-2,  - if one believe case-1 requires the same capability as in legacy BC list when UL switching is not configured, then only 2Tx @ carrier-2 capability is needed additionally (one can further consider when the legacy 1Tx+1Tx capability should be put into the new BC list to avoid network effort on association, i.e., to select between Alt1-1/Alt1-2);  - Or if one believes that case-1 requires different capability than legacy BC list, it must be put into new BC list, for both carrier-1 and carrier-2, so that Alt1-2 should be preferred.  In both case, there seems not reasonable to select Alt1-3, which seems to imply a difference between carrier-1 and carrier-2? If yes, why is that? |
| Huawei |  | First, we understand Alt1-3 has been already agreed. Here the issue is whether 1T+1T needs to be reported for option 2. In any case, reporting (0T+2T) instead of (1T+2T) as OPPO implied seems not feasible. The reason is assuming for band combination A+B+C, UE supports UL Tx switching between A+B and also B+C with B as carrier2, if UE reports (0T+2T) for each pair, eventually, there would be two featureset combinations of (0T+2T+0T) for A+B and B+C, and network cannot tell which featureset combination is for which pair. So we believe we should stick to Alt1-3.  Second, we do not see the need to report 1T capability for carrier2. Our thinking is that the network provides RRC configuration of carrier2 based on 2T capability, and if one capability cannot be used on carrier2, UE may not be able to report it in this 2T capability. |
| Ericsson |  | Concerning the alternatives, our understanding is the same as Huawei that Alt1-3 has been already agreed.  Furthermore, our understanding of this part of the discussion is that it basically intends to align on what the UE could report, so we just need to verify if the signalling allows such case. There is no need to specify anything on this matter if we conclude that the UE can already signal 1Tx+1Tx, if needed. Hence we propose to update the question as:  **whether to report 1Tx+1Tx (case 1) in the new BC list is allowed**  If the UE would report support for 1Tx+2Tx it would as well support 1Tx+1Tx right? Whether the UE on top reports support for option 1 and/or 2 for UL Tx switching, reporting 1TX+2TX seems to cover already both cases. Therefore, we do not see a need for the UE to advertise 1Tx+1Tx in the new BC list. In any case, the UE could anyway report, in the new BC list, another row in FeatureSetCombination where it advertises 1 Tx+1Tx, where the NW could know that it supports therein case 1. So we think this is allowed. |
| CATT |  | Share the same view as Huawei and Ericsson. We already agree the Alt1-3. We also think if the carrier 2 supports 2Tx capability, then the carrier 2 can supports the 1Tx capability as well. Thus, it’s unnecessary to report 1Tx+1Tx in the new BC list. |

For Proposal 2 in [R2-2004756](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_110-e\Docs\R2-2004756.zip), RAN2 to discuss how to make sure NW configuration is applicable for both case 1 and case 2, especially on carrier 2. The SRS configuration was used as an example in the paper as following:

“One logical deduction is NW will configure UE with 1Tx on carrier 1 and 2Tx on carrier 2. If this is the case, careful consideration is required as some parameters for 2Tx is not compliant to 1Tx. One typical example is SRS resource where for 1T4R SRS antenna switch, four SRS symbols are required, while for 2T4R SRS antenna switch, only two symbols are required. Whether other parameters have similar issues also require further check.”

- Chair: can discuss concrete cases by email

### Q4: whether is the network configuration applicable for both case 1 and case 2? If not, is there any concrete case?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | comments |
| Apple | Yes | The originial intension from our paper is to clarify that the configuration to carrie 2 from NW can work well for both case 1 and case 2. SRS resource is only one typical parameter we thought of. From online discussion, it seems NW side can provide multiple SRS resources to UE, thus this particular issue might not exist.  In addition, we do encourage companies to check if other fields also work just fine. |
| Huawei | Yes | We understand this feature is for “dynamic” UL Tx switching, i.e. UE follows L1 signalling to perform Tx switching. Therefore, we think the RRC configuration should not be changed during switching between case1 and case2.  And for SRS resource configuration, as Apple pointed out, from RAN2 signalling perspective, multiple SRS source configuration has been supported in R15, how UE perform SRS transmission should follow RAN1 defined method. Seems no issue identified so far. |
| Ericsson | Yes |  |
| CATT | Yes |  |

**There is another issue that whether the band index indicate carrier role. This will impact the description of the band index in 306CR.** So, rapporteur suggests we discussing it in the CR discussion directly.

- Observation: there is a carrier index in the signalling, but this is not intended to indicate carrier 1 carrier 2.

- Chair: Carrier 1 carrier 2 indication in UE cap, implicit, explicit etc can be discussed by email.

If there is any other issue not included above, please offer it in the following table.

### Q5: Do companies have any other issues or proposals?

|  |  |
| --- | --- |
| Company | Issues/comments |
| Apple | From our understanding, implicit indication should be fine for now as we only have 2Tx at UE. If companies feel we don’t need to worry about futuer proof, it's fine to us not indicate the carrier role.  No strong views though. |
| Huawei | For the agreement “Do not consider the lower order band combination from the parent band combination with UL Tx switching as fallback band combination.”, we would like to further clarify it a little bit.  Our guess is that the intention is “Only consider the lower order band combination with UL Tx switching from the parent band combination with UL Tx switching as fallback band combination.” . For example, for band combination A+B+C, if A+B can switch, then A+B is still the fallback of A+B+C, in this new BC list. |
| Ericsson | If the UE advertises for a given row in Feature set combination Carrier A: 1 Tx Carrier B 2 Tx; if Carrier A can never be carrier 2, the UE simply does not advertise Carrier A with 2 Tx, if it can be, the UE can advertise another row in FeatureSetCombination as Carrier A: 2 Tx Carrier B 1 Tx. |

# Summary

**Proposal 1: to introduce a new band combination list, under which the UE capabilities associated with UL Tx switching are reported.**

**Proposal 2: reporting capability on each UL band pairs per BC that supports UL Tx switching.**

**Proposal 3: introducing a capability reporting DL interruption, which is defined as per band per band combination for each band pair supporting UL Tx switching.**

**Proposal 4a: introducing a per BC capability which reports the supported option in inter-band UL CA case and EN-DC case where UE supports UL Tx switching. For inter-band UL CA case, the candidate values set is {option1, option2, both option 1 and option 2}. For EN-DC case, the candidate values set is {option1, option2}.**

# References

[1] R2-2005219 Report of [Post109bis-e][045][NR16 Other] UL TX Switching-NR\_FR1 (China Telecom)

[2] [R2-2002531](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_109bis-e\Docs\R2-2002531.zip), LS on UE Tx switching period delay and DL interruption (R4-2002816; contact: Apple), RAN4

[3] R2-2004358, LS on Rel-16 RAN1 UE features lists for NR (R1-2003072; contact: NTT DOCOMO, AT&T)

[4] R2-2004375, LS on UE capability on DL interruption for UL Tx switching (R4-2005665; contact: Apple)

[5] R2-2006097 LS on updated Rel-16 RAN1 UE features lists for NR (R1-2004969; contact: NTT DOCOMO, AT&T)