**3GPP TSG RAN WG1 Meeting #103-e R1-2009354**

**e-Meeting, October 26 – November 13, 2020**

**Source: Moderator (Intel Corporation)**

**Title: [103-e-NR-Mob-Enh-02] Discussions Summary #1**

**Agenda item: 7.2.9**

**Document for: Discussion**

# Introduction

In this contribution, we summarize the email reflector discussions for [103-e-NR-Mob-Enh-01]. Chairman has approved the following email discussion:

* [103-e-NR-Mob-Enh-02] Email discussion/approval on the following until 10/29 – Daewon (Intel)
  + Issue#5 in R1-2008871, issue on handling of SUL and DAPS operation

# Recap of issue from R1-2008871

## Issue #5) Handling of SUL and DAPS capability [6]

[6] notes that Based on existing SUL capabilities, it cannot be unambiguously determined whether UE can or cannot support SUL during DAPS HO. Suggest to send an LS to RAN2 to let them know so that they can take this into account.

* Proposal from [6]:
  + RAN1 sends a LS to RAN2 informing that from RAN1 perspective simultaneous operation of SUL and DAPS is not supported in Rel-16.

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| **1. Overall Description:**  RAN1discussed the simultaneous operation of SUL and DAPS and concluded that, in order to limit the UE complexity, RAN1 perspective simultaneous operation of SUL and DAPS is not supported in Rel-16.  **2. Actions:**  **To RAN2:**  **ACTION:** RAN1 respectfully asks RAN2 to take the above information in to account. |

# Summary of Email Discussions

The proposal from [6] suggest sending a LS to RAN2 to inform that simultaneous operation of SUL and DAPS is not supported in Rel-16. This discussion can be split into two separate questions.

**Q1)** Do you agree that simultaneous operation of SUL and DAPS is not supported in Rel-16 from RAN1 perspective?

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| **Company** | **Agree? (Yes/No)** | **Comments for Q1** |
| Qualcomm | Yes with comments | We prefer not to support SUL and DAPS simultaneously (i.e., switching from normal UL to SUL or vice versa together with DAPS HO is not supported). Furthermore, we should further discuss whether UE is configured with switching between SUL and normal UL before DAPS handover if UE indicates support of DAPS. With SUL, we may need to add some clarification to the following spec since it is not clear whether UL BWP is BWP for normal UL or BWP for SUL:  “*For intra-frequency DAPS HO operation, the UE expects that an active DL BWP and an active UL BWP on the target cell are within an active DL BWP and an active UL BWP on the source cell, respectively.*” |
| Huawei/HiSi | depends | A clarification is needed before answering this question. Basically similar to what QC comented.  UE can be configured with only NUL or only SUL or both NUL and SUL for dynamic switching between two of them. When we say simultaneous operation of SUL and DAPS in the Q1), which case(s) are we talking about? In our understanding, there is no issue for UE configured with only SUL to co-work with DAPS simultaneously. The only case there is concern from UE implementation is that when UE configured with both NUL and SUL and the target cell is inter-frequecy with both NUL and SUL, and in such a case, we also perfer to not work simultaneously with DAPS. From UE capablity perspective, the existing UE capablity reporting for SUL feature and DAPS is sufficient so no need to change. Also, when UE is configured both SUL and NUL and the target cell is inter-frequency, how to release one UL of source cell when configuring UE with DAPS is the similar issue as to Scell release/multi-TRP fallback being discussed in RAN2. |
| ZTE | Acceptable | For simplicity, SUL and DAPS cannot be configured simultaneously. But we also have the same questions as pointed out by QC and HW. |
| Apple | Yes | No simultaneously operation between SUL and DAPS HO is preferred. Regarding the reconfiguration from SUL to normal UL before the DAPS HO, this can be discussed in RAN2. |
| MTK | Yes | We also agree on QC’s clarification text on BWP and HW/Apple’s suggestion to discuss the remaining details in RAN2. |
| Samsung | Yes with comments | We prefer not to support SUL and DAPS operations simultaneously. We also have the same questions as pointed out by QC and HW. Further clarifications would be better. |
| Nokia | Yes | The main case we felt needs to be addressed is when SUL is configured so that we can dynamically address e.g. PUSCH on either, or we have at least one of PUSCH/PUCCH/SRS/RACH associated to with one of the two UL carriers of the cell while some other UL transmissions are associated with the other UL carrier.  This may be difficult from UE implementation and definition perspective.  For the case, if we assume that e.g. PUSCH, PUCCH, SRS are only configured to SUL, but not to NUL and also RACH carrier selection always results SUL, for target and source respectively, there could be some option to consider joint operation but would require special configuration.  For case e.g. target has SUL and target NUL if we want to support this case, it would be good to clarify the whether case falls to intra- or inter-frequency. RAN4 currently determines the split among these cases from DL perspective (e.g. ”*A DAPS handover is intra-frequency if the centre frequency of the SSB of the source cell and the centre frequency of the SSB of the target cell are the same, and the subcarrier spacing of the two SSBs are also the same*”), but also assumes that the target(/source) UL BWPs need to be confined within source(/target) UL BWP (see below).  Regarding the BWP related clarification proposed by Qualcomm, RAN4 specification has already following definitions:  In Section 6.1.3 (of 38.133):  “the initial DL and UL BWP of source cell is confined within the active DL and UL BWP of the source cell respectively, and the initial DL and UL BWP of target cell is confined within the active DL and UL BWP of the target cell respectively.”  And then in 6.1.3.2:  “Note:       For intra-frequency DAPS handover, no requirement applies if active DL and UL BWP of target cell is not confined within the active DL and UL BWP of the source cell respectively.  Note:         For inter-frequency DAPS handover, no requirement applies if the BWP of target cell is overlaped with the BWP of source cell in frequency domain.” |
| **Moderator** | - | Summary of discussion so far:   * In case UE is configured with both NUL and SUL, companies seems to think DAPS should not be used simultaneously. * In case UE is configured with only SUL, it is for further debate whether DAPS can be used together. In this case, RAN4 may need to clarify whether this corresponds to intra-frequency or inter-frequency handover. * BWP related aspects seems to be clarified by RAN4 specification. * Sending LS to RAN2 (and RAN4) might be necessary, so that RAN2 and RAN4 can resolve the issues on not support NUL+SUL together with DAPS. |

**Q2)** If Q1 is agreeable, should we send an LS to RAN2?

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| **Company** | **Send LS (Yes/No)** | **Comments for Q2** |
| Qualcomm |  | We can further discuss whether LS to RAN2 is needed after resolving discussions in Q1) |
| Huawei/HiSi | depends | Depends on the conclusion of Q1). In our opinion, as long as we conclude ”when UE configured with both SUL and NUL and the target cell is inter-freq”, LS can be sent to RAN2 to request them to consider the case of SUL also. However, RAN2 has been tasked to solve the issue for Scell release and m-TRP fallback, the solution (i.e., via RRC reconfiguration or defining default UE behavior) can be applied in principle to SUL as well. From this perspecitve, sending the LS is not necessary. |
| ZTE | Yes | An LS is slightly preferred if Q1 is agreed. |
| Apple | Yes | Sending the LS is preferred. |
| MTK | Yes | Sending the LS is preferred. |
| Samsung |  | Depends on the discussion in Q1. |
| Nokia | Yes | We think LS to RAN2 is needed. |
| **Moderator** | - | See moderator comments from Q1 (above). |

Moderator proposal for conclusion:

* Send LS to RAN2 (and possibly RAN4) to inform about SUL and DAPS operation.
* Agree that UE configured with NUL and SUL does not expect to be configured to perform DAPS handover.
* Discuss on UE configured with only SUL can expect or should not expect to be configured to perform DAPS handover.
  + Option 1) UE configured with only SUL does not expect to be configured to perform DAPS handover.
  + Option 2) UE configured with only SUL may be configured to perform DAPS handover.
    - In this option, send the LS also to RAN4 and ask them to clarify how intra-frequency and inter-frequency will be categorized for this situation.

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| **Company** | **Comments on moderator proposal** |
| Qualcomm | We are not ready to send LS to RAN2 yet. We should first discuss to clarify understandings on interraction of SUL and DAPS.  The text ” UE configured with NUL and SUL” is confusing. As specified in TS 38.300 (C&P below), the UE may be configured with SUL in addition to NUL. However, the UE is not scheduled to transmit on both NUL and SUL at the same time. Similarly, the text ” UE configured with only SUL” is also confusing.  --------- “5.4.2 Supplementary Uplink In conjunction with a UL/DL carrier pair (FDD band) or a bidirectional carrier (TDD band), a UE may be configured with additional, Supplementary Uplink (SUL). SUL differs from the aggregated uplink in that the UE may be scheduled to transmit either on the supplementary uplink or on the uplink of the carrier being supplemented, but not on both at the same time.”  ---------  From our understandings, UE may be configured with SUL in addition to NUL. If the UE is ***configured*** with SUL, the UE is **dynamically scheduled (i.e., by DCI) to transmit either on SUL or on NUL at one time**. The dynamic switching between SUL and NUL for UL transmission adds quite complexity on UE. Now having DAPS in addition to the dynamic SUL/NUL switching in handover further complicates UE implementation. Hence, we prefer to not enable dynamic SUL/NUL switching during DAPS HO. However, dynamic SUL/NUL switching may be possible in the source cell before DAPS HO starts or in the target cell after DAPS HO completes.  Not enabling dynamic SUL/NUL switching during DAPS HO should be much simpler than Scell deactivatoin or mTRP deactivation since NW just simply do not activate the switch during HO. Furthermore, since the switching is activated by DCI, why do we need RAN2 get envolved? We believe something in this line can be captured in 213 ” *For DAPS handover, the UE is not expected to be switched between NUL carrier and SUL carrier or between SUL carrier and NUL carrier for transmission if the UE is configured with SUL.*”  **The BWP-related clarification is applicable to SUL operation regardless whether dynamic SUL/NUL switching during HO is enabled or not**. RAN4 notes that NOK quoted just simply capture the note in below RAN1 agreements. Such notes could not clarify whether UL BWP in the BWP text of 213 is for SUL or for NUL if SUL is configured to the UE.  ---------------  Agreement:  For intra-frequency DAPS HO,the UE expects that the active DL and UL BWP of target cell is confined within the active DL and UL BWP of the source cell respectively.   * Note: UE is not expected to meet any intra-frequency DAPS-HO related latency requirements if this condition is not met   --------------  To make the clarification, perhap we can make the following update:  “For intra-frequency DAPS HO operation, the UE expects that an active DL BWP and an active UL BWP on the target cell are within an active DL BWP and an active UL BWP on the source cell, respectively. *If the UE is configured with SUL and scheduled to transmit on SUL carrier, the UL BWP refers to the BWP associated with SUL.*”  Whether transmision on SUL or NUL should not impact to definition of intra- or inter-frequency handover since handover type is based on SSB or CSI-RS. Hence, we do not see the need to send LS to RAN4. |
| Huawei/HiSilicon | Firstly, we also would like to align the understanding of the issue before deciding to send the LS.  Regarding QC’s comment, RRC dedicated signaling can configure SUL only without NUL and it is diffferent from UE configured with both NUL and SUL for the concerned issue. This is why we need clarification of the accurate meaning of ”UE configured with SUL”.  For cooperation with DAPS, as said earlier, we only see the UE implementation concern for the case of UE configured with both NUL and SUL and also the target cell uplink is inter-freq with both NUL and SUL of the source cell which is not expected to operate with DAPS simultenaously. If UE is configured eirther NUL or SUL or the target cell UL is intra-freq with NUL/SUL, there is no probelm to work with DAPS at the same time.  For the solution QC proposed, it does not solve the issue from our point of view. If UE is configured with both NUL and SUL for dynamic switching, but PUCCH can only be configured for either NUL or SUL. If UE was indicated to transmit PUSCH in say NUL but PUCCH is configured on SUL, with QC’s proposed solution, during DAPS, PUCCH will not be able to be transmitted in the source cell. The point to solve the issue should be falling back to a specific UL in source cell for DAPS handover, similar to Scell release or mTRP fall back to be discussed in RAN2.  Regarding the expected clarification on intra/inter-freq, for the SUL case, the intra-freq we cared about is the active uplink BWP of the target cell (we suppose either UL or SUL not both will be configured in target cell) is confined with the active UL BWP of the carrier (either SUL or NUL) of the source cell. If needed, we would be ok to clarify it in RAN1 spec. |
| ZTE | In our understanding, if a serving cell is configured with SUL, it will include two UL, i.e., NUL and SUL. So we guess the UE configured with only SUL means the UE only transmits UL signal on the SUL when SUL is configured. The UE configured with both NUL and SUL means the UE may transmit on the SUL or the NUL with dynamic switching. Correct us if there is something wrong.  We think it is difficult to ensure that UE only transmits UL signals on SUL. For example, the PRACH resource should be configured in the NUL since it is common to all the UE. In this case, the UE should fallback to NUL to transmit PRACH if needed. Thus, dynamic switching occurs. The case of the UE only configured with SUL does not exist.  The simplest way is to release the SUL during handover as long as the source cell is configured with SUL. For the target cell configuration, SUL is not allowed. Therefore, we suggest deleting the third bullet. |
| MTK | My current understanding is similar with QC and ZTE that if a serving cell is configured with SUL, it will include two UL, i.e., NUL and SUL, but we can be wrong. Regarding HW’s comment: “RRC dedicated signaling can configure SUL only without NUL”, can HW further give the RRC dedicated signaling IE so I can check the related spec?  We are fine with QC’s clarification on UL BWP text. |
| Nokia | As noted by Qualcomm and Huawei it might be if we consider the cases in bit more detail. When the PUSCH/PUCCH/SRS are configured only to SUL can we achieve a case when there won’t be any transmission in other carrier (without further RRC configuration)? As noted earlier, we have similar understanding as ZTE that RACH will always be also in NUL carrier, so not sure if we can have actual ‘SUL-only’ scenario.  When subset of UL channels is configured to SUL or NUL (SUL+NUL), if we cannot identify in which combination can be supported (assuming that such exist) based in the existing signaling, it might be best to omit such cases from Rel-16 due to time limit e.g. omit ‘SUL+NUL’. If, like Huawei noted, it is feasible to assume that UE can always support ‘SUL+NUL’ case as long as either of the source cell UL BWPs (SUL or NUL) is infra-frequency (as per earlier definition/assumption of UL BWP “containment” intra-frequency), then it would be sufficient to indicate this to RAN2 to be captured, but we would need to clarify what is the UE UL behavior assumed (see below).  For the intra/inter, apologizes if my question was unclear, but I read Qualcomm response so that if the configuration is from DL perspective intra-frequency, we should follow the RAN1/RAN4 requirement for the ‘containment’ of active UL BWPs in source and target. Apologizes if I misunderstood.  So with this assumption I tend to agree that for the BWP note, if we agreed to have support with DAPS for two active BWPs in UL for source, it might be good to have some clarification. However, the proposed clarification seems to imply that only the active UL BWP of SUL that UE is scheduled to transmit in case of intra-frequency case needs to be contained with the target cell active UL BWP (or wise versa). This does not seem very practical as we have active BWP for both, SUL and NUL. Thus, if we agree the intra-frequency case to cover the case when either, SUL active UL BWP or NUL active UL BWP is ‘contained’ with the target cell active UL BWP, we should aim to capture that i.e. either of the active BWPs is ‘contained’ with target cell UL BWP.  So to clarify the UE UL behavior, if we choose to support the SU+NULL, what should be assumed UE behavior be when one BWP is intra-frequency and the other is not? I.e. would the UE apply power sharing (i.e. UE behavior C as in last meeting) or UL cancellation (UE behavior A) for each channel based on the associated UL BWP relation to target cell active BWP? |
| Huawei/HiSilicon | To respond MTK’s question and other’s comment of “SUL only” case. From signaling perspective, *uplinkConfig* and *supplementaryUplink* are both optional in *ServingCellConfig,* soit is up to NW to configure either of them only. From use cases perspective, if UE performs RACH on SUL, it basically means SUL coverage is better so NW may configure SUL only. Also, dynamic switching between NUL/SUL is UE capability. If UE does not support dynamic switching but support SUL, NW can surely configure SUL only. Also, RAN1 has agreed explicitly NW can configure one of NUL/SUL only but sorry I could not get chance to find the agreement in a short time…  We should point out what cases are not practical to work with DAPS and applies RAN2’s soluton or refer to RAN2’s solution, for example, as we commented earlier, the only case UE has implementation concern is that UE is configured both NUL and SUL and target cell uplink (suppose only one UL) is inter-freq with NUL/SUL of source cell. NW can freely configure a single UL in target cell via handover command, so we always assume the target cell only has one UL for working with DAPS. |

# Summary of Conclusions

To be filled once agreements/conclusions are made in RAN1.

# Reference

1. R1-2007593, “Remaining issues on DAPS,” Huawei, HiSilicon
2. R1-2007738, “Draft CR on intra-frequency DAPS handover,” ZTE
3. R1-2008144, “Draft CR on clarification of processing capability on DAPS HO dropping timeline,” Samsung
4. R1-2008209, “Correction to DAPS HO,” Ericsson
5. R1-2008502, “Remaining issues on per CC UE capability and UL cancellation for DAPS-HO,” MediaTek Inc.
6. R1-2008733, “Remaining physical layer aspects of dual active protocol stack based HO,” Nokia, Nokia Shanghai Bell
7. R1-2008871, “Pre-meeting Issue Summary for NR Mobility Enhancements,” Moderator (Intel Corporation)