**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

### Discussion from Oct 26 to Oct 30:

 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.
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**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). |

### Discussion from Nov 01 to Nov 03:

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 UplinkIn 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.  |
| Huawei/HiSilicon | We are interested in discussing more about DAPS+SUL because we also see these are also both important features. From UE implementation perspective, if UE is configured with both NUL and SUL and target cell is inter-frequency, we see UE implementation concern as we concerned for DAPS and mTRP. Different thing from mTRP+DAPS discussion is that UE can be configured with SUL-only for which case UE can work with DAPS simultaneously. From our point of view, we think it seems straightforward to agree in RAN1 “which cases” is not supported to work with DAPS simultaneously given the discussion in the past in RAN1 and RAN plenary and task RAN2 also to come up with the solution with perception that the solution can in principle to apply to Scell release, mTRP fallback and one UL when configured both release. As to “which case”, we prefer it is “when UE is configured with both NUL and SUL and the active UL BWP of target cell is neither confined within the active UL BWP of NUL nor SUL”. Thanks.  |
| Nokia | I agree with Huawei that it appears that there is at least a consensus  on cases that are not supported i.e. inter-frequency and intra-frequency in case of non-overlapping UL BWPs. Then what seems to be open is to clarify the details of the supported scenario.To summarise, if I have understood the proposals correctly, for all UEs that support DAPS and SUL; * operation DAPS together with SUL in source cell is supported when
	+ dynamic DCI based switching is not configured and
	+ the target and source cell are considered as intra-frequency and
	+ the target cell active UL BWP is contained either source cell active UL BWP (NUL or SUL) or,
	+ one of source cell active UL BWPs is contained to target cell active UL BWP [*Note: this is not said below but my assumption. Please also see a question below*]
* operation with DAPS together with SUL is not supported if target and source are intra-frequency and UL BWPs are not contained as noted above or target and source cell are  inter-frequency.
* DAPS together with SUL in target cell is not supported.

This would be the baseline to define the UE capability without any additional signalling. I.e. minimum capability for all UES that support DAPS and SUL .[*Q: As I’m not intimately familiar with SUL, would we be able to always assume that the source cell NUL carrier(/UL BWP) is overlapping with the target cell UL BWP or can it be also the SUL UL BWP?*]To complete the minimum UE capability, we would still need to clarify in my understanding at least following open issues: * Can the UL channels (PUSCH/PUCCH/SRS) be configured to both carriers, SUL or NUL or do they need to be fixed on either, SUL or NUL? And if so does it matter which carrier it is, i.e. the one that is overlapped with target BWP or not?
	+ I was in the impression that we would require these to be fixed on one carrier only, but is there relevance which carrier it is?
* Is it possible ensured that there won’t be any dynamic UL switching due to RACH? I.e. is it possible to have configuration so that there is no RACH in both active UL BWPs?
	+ This is not completely clear for me, in my understanding RACH is present on both.
* Also the UE behaviour in terms of UL (e.g. cancellation) should also be clarified for the case we agree to be supported, like noted earlier.
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| Huawei/HiSilicon | I agree with Huawei that it appears that there is at least a consensus  on cases that are not supported i.e. inter-frequency and intra-frequency in case of non-overlapping UL BWPs. Then what seems to be open is to clarify the details of the supported scenario.HW-> I do care about inter-freq case, but we care more about whether UE is configured with SUL-only or configured both NUL/SUL in the source cell when to do DAPS. In short, we don’t see problem for UE configured with SUL-only to work with DAPS simultaneously regardless target cell is inter or intra. To summarise, if I have understood the proposals correctly, for all UEs that support DAPS and SUL; * operation DAPS together with SUL in source cell is supported when ->HW-> at least this is not aligned with our proposal, the case together with DAPS is supported is when UE is configured with SUL-only in source cell.
	+ dynamic DCI based switching is not configured and
	+ the target and source cell are considered as intra-frequency and
	+ the target cell active UL BWP is contained either source cell active UL BWP (NUL or SUL) or,
	+ one of source cell active UL BWPs is contained to target cell active UL BWP [*Note: this is not said below but my assumption. Please also see a question below*]
* operation with DAPS together with SUL is not supported if target and source are intra-frequency and UL BWPs are not contained as noted above or target and source cell are  inter-frequency. ->HW-> The case is not supported is that UE is configured both NUL and SUL in source cell. In addition, target cell is inter-freq case.
* DAPS together with SUL in target cell is not supported. ->HW-> As said, we only see the problem is that UE is configured both, so it applies to target cell as well, i.e., DAPS together with target cell configured both NUL/SUL is not supported.

This would be the baseline to define the UE capability without any additional signalling. I.e. minimum capability for all UES that support DAPS and SUL .[*Q: As I’m not intimately familiar with SUL, would we be able to always assume that the source cell NUL carrier(/UL BWP) is overlapping with the target cell UL BWP or can it be also the SUL UL BWP?*]To complete the minimum UE capability, we would still need to clarify in my understanding at least following open issues: * Can the UL channels (PUSCH/PUCCH/SRS) be configured to both carriers, SUL or NUL or do they need to be fixed on either, SUL or NUL? And if so does it matter which carrier it is, i.e. the one that is overlapped with target BWP or not?

HW-> If UE is configured with both NUL and SUL, PUCCH can only be configured in one UL, but PUSCH/SRS can be configured on both but dynamically switching and if UE has capability, SRS on one UL can be transmitted together with other channel (PUSCH/PUCCH/SRS) on the other UL. However, if UE is configured with NUL-only or SUL-only, surely all these channels have to be on the configured UL. * + I was in the impression that we would require these to be fixed on one carrier only, but is there relevance which carrier it is?
* Is it possible ensured that there won’t be any dynamic UL switching due to RACH? I.e. is it possible to have configuration so that there is no RACH in both active UL BWPs?
	+ This is not completely clear for me, in my understanding RACH is present on both.

HW-> For initial access, i.e., before RRC setup, UE can choose which UL for PRACH transmission and the PUSCH scheduled by RAR is transmitted on the same UL as PRACH. After RRC setup, NW can configure UE SUL only, for example, in the case of UE chose SUL for initial access, in which case it implies SUL has better coverage. In case UE is configured with both NUL and SUL after RRC setup, for PRACH issue (happens by PDCCH order) , you can find this “If a UE is configured with two UL carriers for a serving cell and the UE detects a PDCCH order, the UE uses the UL/SUL indicator field value from the detected PDCCH order to determine the UL carrier for the corresponding PRACH transmission.” in 38.213. * Also the UE behaviour in terms of UL (e.g. cancellation) should also be clarified for the case we agree to be supported, like noted earlier.

HW-> Like the case I am talking about: when UE is configured with both NUL and SUL and in addition target cell uplink BWP is not confined within NUL or SUL. For DAPS, one of UL has to be released as Scell release or mTRP fallback regardless whichever option RAN2 will agree. So in DAPS operation, only one UL exists, cancelation will applies to whichever UL that remains. There might not be additional spec impact I presume.  |
| Samsung | We agree that it may need a bit more time for the clarification.To Huawei:To better align of understanding and decide which case to support or not, in the following 2 cases:Case 1: NUL+SUL is configured in source cell and target cell is inter-frequency Case 2: NUL+SUL is configured in source cell and target cell is intra-frequency to SUL or NUL Could you share the reason why you think UE implementation has concerns on case 1 but not case 2? At first glance Case 1 is more difficult due to more potential UL switching/transitions especially for single TX solution. However, give NUL and SUL is designed to not transmit in the same time,  the addition UL switching/transitions happen between source/target cell, which UE should able to support it when it support inter-frequency DAPS HO. Other than # of UL switching/transitions, we would say additional UE burden of DAPS HO on top of SUL operation is higher in Case 2.So it is not an easy call for us to determine which case is more difficult in term of UE implementation. At this stage, we may incline to be conservative and not to support both cases. But we want to hear other companies opinions. |
| ZTE | It is clarified that UE configured with only SUL means there is no NUL configured for the this UE. We would like to say it is not true. The SUL can only be attached to a TDD cell according to the band combination defined by RAN4, which means the NUL always exists. In addition, it is clearly clarified in TS38.300-g20 that a UE will be configured with two ULs in case SUL is configured. It should be noted it is not 'one or two ULs'.

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| 6.9 Supplementary UplinkIn case of Supplementary Uplink (SUL, see TS 38.101-1 [18]), the UE is configured with 2 ULs for one DL of the same cell, and uplink transmissions on those two ULs are controlled by the network to avoid overlapping PUSCH/PUCCH transmissions in time. Overlapping transmissions on PUSCH are avoided through scheduling while overlapping transmissions on PUCCH are avoided through configuration (PUCCH can only be configured for only one of the 2 ULs of the cell). In addition, initial access is supported in each of the uplink (see clause 9.2.6). An example of SUL is given in Annex B. |

Regarding the comments that uplinkConfig and supplementaryUplink are both optional, we understand that the purpose of setting RRC IEs as optional is to save signaling overhead and it cannot justify only SUL can be configured. On the contrary, it is clarify that SUL cannot be configured alone in the description for the *supplementaryUplinkConfig* in the IE *ServingCellConfigCommon* in TS38.331 as shown below.

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| ***supplementaryUplinkConfig***The network configures this field only if *uplinkConfigCommon* is configured. If this field is absent, the UE shall release the *supplementaryUplinkConfig* and the *supplementaryUplink* configured in *ServingCellConfig* of this serving cell, if configured. |

Therefore, we understand the UE configured with only SUL here we discuss does not exist. That is the reason why we would like clarify it at first.  In this case, we think there is no need to further discuss this scenario at this stage. |
| Huawei/HiSilicon | To respond ZTE’s comment:* NUL exists for TDD BC for SUL does not mean it has to be in RRC dedicated configuration.
* 300 is stage 2 spec, which does not intend to cover all cases in details.
* The description of *supplementaryUplinkConfig* means *uplinkConfigCommon* present in common configuration. In dedicated configuration, SUL can be configured with no NUL.
* As RAN2 has agreed (highlighted in yellow as follows) in RAN2#100,

**Agreements**1: Common configuration and dedicated configuration for the UL and SUL can be independent. (Agreement is not meant to preclude any discussion in UP session)2 Common configurations for both non-SUL and SUL can be provided to the UE3 UE is configured with PUCCH and PUSCH dedicated configuration for either UL or SUL4 UE can additionally be configured a PUSCH on the other carrier.5 For reconfiguration with synchronisation, the UE can be provided with RACH dedicated configuration for either UL or SUL.So UE is not limited to be configured with NUL for dedicated configuration when be configured with SUL. UE configured with SUL-only exists.   |
| Nokia | Regarding the ‘SUL-only’ option, I tend to agree with ZTE, that also in my understanding there always will be “NUL” configuration (and possibly SUL in addition). Also, as noted already earlier, we do agree that when we have NUL+SUL, PUSCH and PUCCH can be configured to one carrier only, and additionally PUSCH to other carrier as well. If we cannot come to a common understanding on the possibility of ‘SUL-only’ we could ask RAN2 guidance.But setting that aside, there at least appears to be consensus on some of the cases (apologizes if I’m again mistaken):* The (DL) inter-frequency case (when both NUL and SUL uplink configurations exist) is not supported.
* The (DL) intra-frequency case (with NUL+SUL), when there is no overlap/containment with target and source BWPs, it won’t be supported.

For the (DL) intra-frequency case, where either of the source cell UL BWPs is contained with target cell UL BWP (or vice versa) there seems to be two views, to support or not to support. Like noted, we are in principle fine with both options as long as we also agree in case of support what is the expected UE UL behaviour. |
| ZTE | To response HW’s comments:* The stage 2 spec at least can reflect the common understanding that a cell with 2 ULs is the normal case for SUL. It is well known that NR has a great flexibility. Allowing the UE to be configured with PUCCH/PUSCH dedicated configuration for either SUL or NUL is just for the purpose of higher flexibility. It does not mean that SUL-only is a normal case or we have to support this case with some optimization.
* For TDD cell, the NUL can utilize the reciprocity of the UL and DL for more efficient transmission while the SUL cannot. Therefore, the NUL and SUL are configured together in most cases. If the load on the NUL is not large, the UE performs transmission on the NUL. If the load on the NUL is large, the UE performs transmission on the SUL. We do not see the benefits of SUL-only comparing with NUL+SUL. Regarding the larger coverage of SUL, we do not think it is a strong reason to configure a UE with SUL only because the cell coverage should be the NUL coverage in the deployment due to the fact that the network cannot presume all the UEs can support SUL. Therefore, when a UE move to the edge of the NUL coverage, the handover may happen and in this case NUL can also be used.
* So when a UE accesses to a serving cell, why is it configured with only on SUL. Alternatively, if the UE is configured NUL+SUL at first, it is straightforward to release the SUL but not NUL during the DAPS handover.
* For intra-frequency handover, it is restricted that the active UL BWP of the target cell is within the active UL BWP of the source cell. If there is only SUL configured for the source cell, it will force the target cell should also be configured with SUL but not NUL. Therefore, it will force the target cell should also support SUL, which is not good.
* All what we do is to reduce the UE implementation complexity during DAPS handover. The simplest way is to release the SUL in case the SUL is configured, just like release the second TRP in case mTRP is configured. We prefer not to discuss this corner case at this stage especially considering that this scenario may need RAN2/RAN4 to further clarify as commented above.
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| Huawei/HiSilicon | In the entire arguing, I did not say SUL-only is a normal case, but rather the case is possible from either RAN2 signaling perspective or agreement perspective. Also, I did not say UE is configured with SUL-only when UE accesses a cell. Instead, I was saying after RRC setup, in dedicated configuring, SUL-only can be configured. RAN2 agreement clearly says “dedicated configuration for either NUL or SUL”. Also, even though UE is configured with SUL-only in the source cell, the intra-freq case does not force NW to deploy SUL also for target cell. Instead, UE can support this case together with DAPS. Also, what is the corner case? I will laugh if people argue UE being configured with SUL is the corner case. I doubt what people’s intention is by twisting the meaning of our comments and constantly counter arguing the SUL-only cases.Anyhow, the case we concerned working with DAPS from UE implementation is UE configured with both NUL AND SUL and the target cell uplink BWP is confined within either NUL or SUL. Since the primary arguing lies what “configured with SUL” really means, we can make it specific, similar to the two bullets as Nokia suggested. * When UE is configured both NUL and SUL uplink, the inter-frequency case (target cell uplink BWP is not confined within the uplink BWP of NUL nor NUL) is NOT supported to work with DAPS.
* When UE is configured both NUL and SUL uplink, the intra-frequency case (target cell uplink BWP is confined within the uplink BWP of NUL or NUL) is supported to work with DAPS.
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| Qualcomm | Perhaps let us continue discussion based on the suggestion Nokia and Huawei suggested for the case when the UE is configured with both NUL carrier and SUL carrier:* For the inter-frequency DAPS handover, UE does not expect to be configured with SUL carrier. In particular, SUL configuration is released. RAN1 sends LS to RAN2 for SUL configuration release signalling.
* For the intra-frequency DAPS handover, we should clarify UL BWP condition which may depends on whether target cell is co-channel with the NUL carrier or SUL carrier. Hence, we suggest the following clarification in TS 38.213:

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| “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 uplink transmisison to the source cell on SUL carrier that is co-channel with the target cell, the UE expects that the active UL BWP on the target cell is within an active UL BWP of the SUL carrier on the source cell. If the UE is configured with uplink transmisison to the source cell on SUL carrier and the source cell on NUL carrier is co-channel with the target cell, the UE expects that the active UL BWP on the target cell is within an active UL BWP of the NUL carrier on the source cell.*” |

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| ZTE | [HW’s comments] Also, even though UE is configured with SUL-only in the source cell, the intra-freq case does not force NW to deploy SUL also for target cell. Instead, UE can support this case together with DAPS. [ZTE] If the UE is configured with SUL-only and the target cell does not support SUL (e.g., the target cell only has NUL) , could you explain how to satisfy the requirement of the active UL BWP of the target cell within the active UL BWP of the source cell in intra-frequency? In this case, it means the active BWP of the NUL of the target cell is within the active BWP of the SUL of the source cell. Anyway, we can skip this question if we only focus the SUL AND NUL. [HW’s comments] Also, what is the corner case? I will laugh if people argue UE being configured with SUL is the corner case. [ZTE] We guess there must be misunderstanding. We never say UE being configured with SUL is the corner case. If you read our comments again, you will find we just believe the SUL-only is the corner case since we can’t imagine the reason for such configuration and thus there is no need to discuss SUL-only.We are fine to just focus on the SUL+NUL. And we think the preliminary consensus has been reached as in the second bullet of the moderator proposal. Regarding the further discussion in the intra/inter-frequency with SUL+NUL, our preference is to use the same solution for the intra-frequency and inter-frequency, i.e. release the SUL during DAPS. In addition, we also have the same question on UE implementation complexity as pointed out by Samsung.  |
| Huawei/HiSilicon | I found my early response to Samsung’s question is missing in this summary which is replied in email text. I copy-paste it here again:To respond Samsung:It pretty much depends on UE implementation, but I can give you an quick UE implementation example why inter-freq (case 1) has more concern. If UE has two Tx chains (one for NUL and the other for SUL) for the case NUL+SUL is configured, then the two Tx chains will be occupied by the two UL carriers in the source cell, so there is no other tx chain for target cell uplink if it is inter-freq (case 1) assuming none of tx chain of source cell cannot be shared with the target cell uplink to support DAPS. Not sure whether Samsung is satisfied with this reply, but I did not receive further response from Samsung. Back to how to move forward, since the common ground people can have so far is that when UE is configured with both NUL and SUL in source cell and [the target cell is inter-freq], for DAPS, one of UL needs to be released. Regarding the text in [], I’d like to hear whether there are more comments given my response to Samsung’s question might be missed by some companies. Assuming no further comment regarding the text in [], we suggest RAN1 agreeing the following proposal and up to RAN2 for detailed solution as agreed in RANP for mTRP+DAPS issue and come back later to see if any RAN1 impact needed. **Proposal**:*UE is not required to support simultaneous operation of DAPS when UE in source cell is configured with both NUL and SUL and the uplink BWP of target cell is neither confined with uplink BWP of NUL nor uplink BWP of SUL.* * Up to RAN2 for the solution to avoid *UE operates the above case with DAPS simultaneously*.
* Send LS to RAN2 to take this into consideration.
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| MTK | We are fine with HW’s latest proposal. It seems to also address the issue for QC’s proposal about UL BWP for 38.213.  |
| Apple | Based on HW’s latest proposal, the case of SUL+NUL in source cell and SUL(/NUL) overlapped in target cell is supported. , we are not clear the UE behaviour, as the NUL or SUL is dynamic scheduled by the source cell, so the case of non-overlap between source cell UL and target UL in frequency domain will happen. In another word, whether intra-frequency DAPS or inter-frequency DAPS is depending on scheduling, but UE capability is defined separately on intra-frequency or inter-frequency. so maybe the proposal could be updated as,*UE is not required to support simultaneous operation of DAPS when UE in source cell is configured with both NUL and SUL or UE is dynamic scheduled on NUL or SUL in target cell ~~and the uplink BWP of target cell is neither confined with uplink BWP of NUL nor uplink BWP of SUL~~.*  |
| Huawei/HiSilicon | Thanks Chunhai for comments in the constructive direction. In our understanding, UE does not know whether NW will trigger UE to switch between two uplink carriers in the source cell unless UE get the DCI. Releasing one UL for DAPS is right to mitigate UE implementation concern by avoiding the unpredictable dynamic NW scheduling behavior. As explained to Samsung’s question, if UE has two Tx chains and both are occupied due to being configured with NUL+SUL in source cell, if the target cell is inter-freq, there is no other Tx chain for DAPS if one of UL in source cell is not released. In addition, target cell can generate target cell configuration before DAPS, so in the concerned case, target cell is more likely not configure two UL. The concern is more from source cell, because UE may have been configured with both NUL and SUL before DAPS. The purpose is to release one UL of source cell for operating DAPS. So from all these aspects, the originally suggested proposal makes more sense from our perspective. **Proposal**:*UE is not required to support simultaneous operation of DAPS when UE in source cell is configured with both NUL and SUL and the uplink BWP of target cell is neither confined with uplink BWP of NUL nor uplink BWP of SUL.* * Up to RAN2 for the solution to avoid *UE operates the above case with DAPS simultaneously*.
* Send LS to RAN2 to take this into consideration.
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| Nokia | Thank you for the good discussion, seems that we are progressing.For the clarification with the BWP aspect, as proposed by Qualcomm, is bit confusing to me. It introduces a new term co-channel, which to me is not same thing as assuming one BWP to be contained with the other BWP. Another aspect that seems to be bit unclear, how does this address the RACH as noted earlier. The wording discusses the case when UE is configured with UL transmission on either NUL or SUL carrier, but in my understanding, RACH configuration is always present in NUL carrier at least. Also, if I’ve I understood correctly, we are assuming that SUL+NUL is not configured to the target cell in DAPS handover. Hence would it be simplest focus to the case that the source cell active NUL BWP is contained with the target cell active UL BWP? This would remove the need to consider the UL behavior as it could follow the normal intra-frequency case (UE applies UL cancellation). Therefore, proposing to adjust as follows:

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| “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. For intra-frequency DAPS HO operation, i*~~I~~f the UE is configured with suplementary uplink ~~transmisison t~~on the source cell ~~on SUL carrier that is co-channel with the target cell, the~~ UE expects that the active UL BWP on the target cell is within an active UL BWP of the N~~S~~UL carrier on the source cell~~. If the UE is configured with uplink transmisison to the source cell on SUL carrier and the source cell on NUL carrier is co-channel with the target cell, the UE expects that the active UL BWP on the target cell is within an active UL BWP of the NUL carrier on the source cell~~.*” |

If we want to cover the case that target cell UL BWP is contained with the SUL carrier BWP, then it we would need further clarification what is the expected UL behavior.Finally, it would in my view make sense to be more precise what is supported and what is not supported. Hence we would propose to modify the proposal to cover all the scenarios we appear to have consensus:**Proposal**:*UE is not required to support simultaneous operation of DAPS with NUL and SUL configured in target cell.**In case of inter-frequency DAPS handover, UE is not required to support simultaneous operation of DAPS with NUL and SUL configured in source cell.**In case of intra-frequency DAPS handover, UE is not required to support simultaneous operation of DAPS when UE in source cell is configured with both NUL and SUL and the uplink BWP of target cell is not~~either~~ confined within active uplink BWP of NUL carrier~~nor uplink BWP of SUL~~.* * Up to RAN2 for the solution to avoid *UE operates the above case with DAPS simultaneously*.
* Send LS to RAN2 to take this into consideration.
 |
| Qualcomm | Nokia: By co-channel, we meant they are in the same carrier. We’re fine with your suggestion on BWP clarification.Please find our suggested proposal update below:**Updated Proposal**:*UE is not required to support simultaneous operation of DAPS with NUL and SUL configured in target cell.**In case of inter-frequency DAPS handover, UE is not required to support simultaneous operation of DAPS with NUL and SUL configured in source cell.**In case of intra-frequency DAPS handover, UE is not required to support ~~simultaneous~~ ~~operation of~~ DAPS when UE ~~in source cell~~ is configured with both NUL and SUL in source cell and the active uplink BWP of target cell is not~~either~~ confined within active uplink BWP of NUL carrier~~nor uplink BWP of SUL~~.* * Up to RAN2 for the solution to avoid *UE operates the above case with DAPS simultaneously*.
* Send LS to RAN2 to take this into consideration.

*Capture the following in Section 15 of TS 38.213** 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. For intra-frequency DAPS ~~HO~~ handover operation, i*~~I~~f the UE is configured with suplementary uplink ~~transmisison t~~on the source cell ~~on SUL carrier that is co-channel with the target cell, the~~ UE expects that the active UL BWP on the target cell is within an active UL BWP of the N~~S~~UL carrier on the source cell.*

 *The UE is expected to be configured in the target cell with NUL carrier only. For inter-frequency DAPS handover operation, the UE is not required to support DAPS operation if both NUL carrier and SUL carrier are configured in the source cell.* |
| Samsung | We can accept that simultaneously NUL+SUL and inter-frequency DAPS-HO will cause some UE issue based on HW’s answer. We still prefer unified solution for inter/intra-frequency DAPS, but we are ok with the current direction as long as the UE behavior is clear. One question to QC/Nokia’s latest proposal: Under this change, it seems the intra-frequency DAPS effectively happens in NUL under NUL+SUL configuration, what is the additional benefit to support only this scenario? (comparing to let RAN2 avoid NUL+SUL during the intra-frequency DAPS, a.k.a, not supporting simultaneously NUL+SUL and intra-frequency DAPS) |
| Moderator | Its seems we are converging. I’ve made summary of discussion progress so far below.  |

### Discussion from Nov 03 to TBD:

Moderatory Suggestion for agreement:

* UE is not required to support simultaneous operation of DAPS with NUL and SUL configured in target cell.
* In case of inter-frequency DAPS handover, UE is not required to support simultaneous operation of DAPS with NUL and SUL configured in source cell.
* In case of intra-frequency DAPS handover, UE is not required to support DAPS when UE is configured with both NUL and SUL in source cell and the active uplink BWP of target cell is not confined within active uplink BWP of NUL carrier.
* Up to RAN2 for the solution to avoid UE operates the above case with DAPS simultaneously.
* Send LS to RAN2 to take this into consideration

Moderatory Suggestion for agreement:

* [Agree to TP#1 for Section 15 of TS38.213]

#### **TP#1**

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| * 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. For intra-frequency DAPS handover operation, if the UE is configured with suplementary uplink on the source cell UE expects that the active UL BWP on the target cell is within an active UL BWP of the NUL carrier on the source cell.

The UE is expected to be configured in the target cell with NUL carrier only. For inter-frequency DAPS handover operation, the UE is not required to support DAPS operation if both NUL carrier and SUL carrier are configured in the source cell. |

There was suggestion to agree to the TP in 38.213. Moderator wanted to ask if we are going to ask RAN2 to develop solutions to resolve as mentioned above, do we still need the corresponding TP in 38.213? It seems to be duplicating the resolutions in RAN1 and RAN2. If companies can further on whether both agreement+LS and TP for 38.213 are needed or not.

Moderator thinks we should not duplicate work in RAN1 and RAN2. Please provide further comments on the proposed agreement and TP#1.

Also continue with the discussions. Samsung had noted few questions which were not answered yet. Moderator suggests to further clarify and discuss the issues.

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|  **Company** | **Comments on moderator proposal** |
| Huawei/HiSilicon  |  Thanks FL for the summary. Regarding the proposals, we are fine with all remaining four bullets execpt the bullet for ”intra-freq” case:* In case of intra-frequency DAPS handover, UE is not required to support DAPS when UE is configured with both NUL and SUL in source cell and the active uplink BWP of target cell is not confined within active uplink BWP of NUL carrier.

We don’t think this bullet is needed. Target cell is free to configure NUL or SUL, i.e, if people still have concern that NW can configure SUL-only, as discussed earlier, we can ask this specific question to RAN2 in the LS for calrification whether such a case exists. If yes, then this bullet is not needed.Suggested proposal based on FL’s version: * UE is not required to support simultaneous operation of DAPS with NUL and SUL configured in target cell.
* In case of inter-frequency DAPS handover, UE is not required to support simultaneous operation of DAPS with NUL and SUL configured in source cell.
* Up to RAN2 for the solution to avoid UE operates the above case with DAPS simultaneously.
* Send LS to RAN2 to take this into consideration
* In the LS, captured the following:

RAN1 also discussed the following case, but there is no consensus on this case due to dependence on whether target cell can be configured with SUL-only for DAPS. * + In case of intra-frequency DAPS handover, UE is not required to support DAPS when UE is configured with both NUL and SUL in source cell and the active uplink BWP of target cell is not confined within active uplink BWP of NUL carrier.

Regarding the changes to 38.213, we prefer to discuss it later once RAN2 has conclusion as handled to CA and mTRP.  |
| Huawei/HiSilicon2 | After furhter checking RAN2 spec, in handover command i.e., *RecofnigureationWithSync*, RACH for target cell is choice betweeen *uplink* and *supplementaryuplink* , so it is clear that target cell can be configured with *supplementaryuplink* for RACH, then no need to ask RAN2 to clarify it. Therefore, overall, we sugget the proposal is updated as follows:Suggested proposal based on FL’s version: * UE is not required to support simultaneous operation of DAPS with NUL and SUL configured in target cell.
* In case of inter-frequency DAPS handover, UE is not required to support simultaneous operation of DAPS with NUL and SUL configured in source cell.
* Up to RAN2 for the solution to avoid UE operates the above case with DAPS simultaneously.
* Send LS to RAN2 to take this into consideration
 |
| Nokia  | My thanks for FL for the summary.As ZTE commented over email, I think the bullet for intra-frequency behaviour would be needed if we want to consider the intra-frequency case with both SUL and NUL carrier configured. But, unless I’m mistaken, it now appears, that companies don’t want to consider to support case when SUL and NUL are configured and would prefer want to focus only to the case that “SUL-only” is configured (conditioned that it is possible, which I don’t think it is as noted earlier) we are fine to preclude also the intra-frequency completely and inform RAN2 that RAN1 consider that only cases with single UL configuration can be supported in DAPS. As this discussion prolongs, this starts to appear as the final point remaining, we can try to agree. So, if I’ve now understood correctly should we modify as follows:* UE is not required to support simultaneous operation of DAPS with NUL and SUL configured in target cell.
* In case of inter-frequency DAPS handover, UE is not required to support simultaneous operation of DAPS with NUL and SUL configured in source cell.
* In case of intra-frequency DAPS handover, UE is not required to support simultaneous operation of DAPS with NUL and SUL configured in source cell. ~~DAPS when UE is configured with both NUL and SUL in source cell and the active uplink BWP of target cell is not confined within active uplink BWP of NUL carrier.~~
* UE is only required to support DAPS operation when single UL is configured in target and source cell.
	+ Note: RAN1 could not reach consensus whether it is possible to configure UE with only active SUL BWP without active NUL BWP.
* Up to RAN2 for the solution to avoid UE operates the above case with DAPS simultaneously.
* Send LS to RAN2 to take this into consideration

Note that above text could be pruned/simplified.Regarding TP#1, I tend to agree what we don’t need to have all the text in RAN1 specification as RAN2 should prevent the configurations. Thus, green text should be removed.However, if we want to still consider the case that NUL and SUL BWPs are configured to the source cell in intra-frequency, the BWP related red text could be considered to be introduced in RAN1 specification as we already have the wording for the BWP for the intra-frequency case. If do not want to support case that NUL and SUL BWPs are configured to the source cell in intra-frequency, then we don’t appear to need any change to RAN1 specification as RAN2 can solve/restrict the configuration.Just to repeat, as discussed in length we don’t have consensus that ‘SUL-only’ case exist. My reading of the RAN2 agreement quoted earlier related only to the configuration of PUSCH and PUCCH, not to configuration of “SUL-only”. But that we are fine to limit to single UL option if companies feel strongly about it. |
| Apple |  I agree with Nokia’s proposal if my understanding is correct. I think, with below bullet, the above two bullet related to inter-frequency and intra-frequency can be removed.* UE is only required to support DAPS operation when single UL is configured in target and source cell.

 Otherwise we need re-interpret what is intra or inter frequency DAPS. Previously, there is only one UL carrier/BWP in each cell, now we have two UL carriers/BWP on source cell if both NUL and SUL are configured. For below figures, it’s clear that case 1 is inter-frequency DPAS HO. How about case 2? NUL BWP in target cell is within the NUL BWP of source cell. If it is intra-frequency DAPS, then SUL should be released, otherwise the case 2 is inter-frequency DAPS.I would like to know what common understanding is on inter-frequency/intra-frequency DPAS for NUL+SUL.

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| Case 1 | Case 2 |

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# 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)