**3GPP TSG RAN WG1 Meeting #101-E R1-200xxxx**

**e-Meeting, May 25 – June 05, 2020**

**Source: Moderator (Intel Corporation)**

**Title: Summary of email discussions for [101-e-NR-Mob-Enh-01]**

**Agenda item: 7.2.9**

**Document for: Discussion**

# Introduction

In this contribution, we summarize the email discussion approved for discussion during RAN1 #101-E. Chairman has approved three email discussion threads for RAN1 #101-E. The following are the approved email discussions:

* [101-e-NR-Mob-Enh-01] Email discussion/approval of Issue #1 (UL cancellation for DAPS) and #3 (UL overlapping transmission) in R1-2003747 by 5/29; if necessary, endorse the associated TPs by 6/4 – Daewon (Intel)
* [101-e-NR-Mob-Enh-02] Email discussion/approval of Issue #5 (Power sharing mode for UL DAPS-HO) in R1-2003747 by 5/28; if necessary, endorse the associated TPs by 6/3– Daewon (Intel)
* [101-e-NR-Mob-Enh-03] Email discussion/approval of Issue #6 (PDCCH monitoring in DL DAPS-HO) in R1-2003747 by 5/28; if necessary, endorse the associated TPs by 6/2– Daewon (Intel)

This contribution summarizes the email discussion for [101-e-NR-Mob-Enh-01].

# Email Discussion [101-e-NR-Mob-Enh-01]

This discussion is regarding the uplink cancellation and uplink transmission overlapping issue in UL DAPS-HO (Issue #1 and #3 from [11]).

**Issue and Proposal Summary:**

## Issue #1) Uplink cancellation in UL DAPS-HO [1][2][3][5][6][8]

In RAN1 #100bis-e, TP on uplink cancellation rules for UL DAPS was agreed. However, the TP contained various brackets left for confirmation. Several companies have provided input on this issue. The following is a summary of proposals from contributions.

* Proposal [1]:
	+ The timeline for cancellation is defined as PUSCH preparation time assuming d2,1 = 1 and SCS is the smallest SCS between the SCS configuration of PDCCH in the target cell and the SCS configuration of the UE transmission on the source cell.
	+ Symbol-based cancellation should be supported for DAPS handover.
	+ UL cancellation should be mandatory for a UE supporting DAPS handover and no separate UE capability is needed.
	+ The following is the proposed TP:

### TP#1-1

|  |
| --- |
| 15 Dual active protocol stack based handover<---------------------------Other parts are omitted ------------------------------->If - the UE is~~does not~~ provided with *UplinkPowerSharingDAPS-HO-mode*, and - UE transmissions on the target cell and the source cell overlapthe UE transmits only on the target cell, and cancels the transmission to source cell after the PUSCH preparation time *T*proc,2 for the corresponding PUSCH processing capability [6, TS 38.214] assuming *d*2,1 = 1 after a last symbol of a CORESET where the UE detects a DCI format scheduling the transmission on the target cell and μ corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format and the SCS configuration of the UE transmission on the source cell. If the UE transmits PRACH using 1.25 kHz or 5 kHz SCS on the source cell, the UE determines *T*proc,2 assuming SCS configuration *μ*=0. A UE does not expect to cancel a transmission on the source cell in symbols from the set of symbols that occur, relative to a last symbol of a CORESET where the UE detects a DCI format scheduling a transmission on the target cell, after a number of symbols that is smaller than the PUSCH preparation time *T*proc,2 for the corresponding PUSCH processing capability [6, TS 38.214] assuming *d*2,1 = 1 and *μ* corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format and the SCS configuration of the UE transmission on the source cell. If the UE transmits PRACH using 1.25 kHz or 5 kHz SCS on the source cell, the UE determines *T*proc,2 assuming SCS configuration *μ*=0<---------------------------Other parts are omitted -------------------------------> |

* Proposal [2]:
	+ The complexity for DAPS cancellation is not the same as cancellation for SFI and suggest relaxing the cancellation timeline.
	+ The UE doesn’t need to treat UL transmissions sub-sequent to a cancelled UL transmission in a special manner.
	+ The following is the proposed TP:

### TP#1-2

|  |
| --- |
| < Start of the text proposal >**15 Dual active protocol stack based handover**< Unchanged parts are omitted >If - the UE does not provide *UplinkPowerSharingDAPS-HO*, and - UE transmissions on the target cell and the source cell overlap the UE transmits only on the target cell, and cancels the transmission to source cell after *T*proc,2+2, where *T*proc,2 is the PUSCH preparation time for the corresponding PUSCH processing capability [6, TS 38.214] assuming *d*2,1 = 1 after a last symbol of a CORESET where the UE detects a DCI format scheduling the transmission on the target cell and μ corresponds to the smallest SCS configuration among the SCS configuration of the PDCCH carrying the DCI format, the SCS configuration of the UE transmission on the target cell, and the SCS configuration of the UE transmission on the source cell. If the UE transmits PRACH using 1.25 kHz or 5 kHz SCS on the source cell, the UE determines *T*proc,2 assuming SCS configuration *μ*=0. A UE does not expect to cancel a transmission on the source cell that occurs, relative to a last symbol of a CORESET where the UE detects a DCI format scheduling a transmission on the target cell, after a number of symbols that is smaller than *T*proc,2+2 for the corresponding PUSCH processing capability [6, TS 38.214] assuming *d*2,1 = 1 and *μ* corresponds to the smallest SCS configuration among the SCS configuration of the PDCCH carrying the DCI format, the SCS configuration of the UE transmission on the target cell, and the SCS configuration of the UE transmission on the source cell. If the UE transmits PRACH using 1.25 kHz or 5 kHz SCS on the source cell, the UE determines *T*proc,2 assuming SCS configuration *μ*=0.< End of the text proposal > |

* Proposal [3]:
	+ UE either cancels the whole source UL transmission, or keep the whole source UL transmission, depending on the beginning time of the source UL transmission, relative to the ending time of received target CG DCI.



**Figure from [3]: Symbol level UL transmission cancellation from agreed TP for DAPS**

* + The following is the proposed TP:

### TP#1-3

|  |
| --- |
| 15 Dual active protocol stack based handoverIf - the UE does not provide *UplinkPowerSharingDAPS-HO*, and - UE transmissions on the target cell and the source cell overlap the UE transmits only on the target cell, and cancels the whole transmission to source cell if the occasion of the first symbol of source cell transmission is after ~~[~~the PUSCH preparation time *T*proc,2 for the corresponding PUSCH processing capability [6, TS 38.214] assuming *d*2,1 = 1 after a last symbol of a CORESET where the UE detects a DCI format scheduling the transmission on the target cell and *μ* corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format and the SCS configuration of the UE transmission on the source cell. If the UE transmits PRACH using 1.25 kHz or 5 kHz SCS on the source cell, the UE determines *T*proc,2 assuming SCS configuration *μ* = 0.~~]~~A UE does not expect to cancel a transmission on the source cell ~~[in symbols from the set of symbols]~~ with first symbol that occurs, relative to a last symbol of a CORESET where the UE detects a DCI format scheduling a transmission on the target cell, after a number of symbols that is smaller than the ~~[~~PUSCH preparation time *T*proc,2 for the corresponding PUSCH processing capability [6, TS 38.214] assuming *d*2,1 = 1 and *μ* corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format and the SCS configuration of the UE transmission on the source cell. If the UE transmits PRACH using 1.25 kHz or 5 kHz SCS on the source cell, the UE determines *T*proc,2 assuming SCS configuration *μ* = 0~~]~~. |

* Proposal [5]:
	+ *T*proc,2 provides a reasonable timeline requirement for UE for canceling.
	+ UE behavior for symbol based cancellation has already existed in Rel-15, there is no apparent reason that UE cannot support it. The system performance is clear better with the symbol based cancellation.
	+ Support UL cancellation rules for Msg 3.
	+ The following is the proposed TP:

### TP#1-4

|  |
| --- |
| **Text proposal #1 for section 15 in TS38.213**A UE does not expect to cancel a transmission on the source cell in symbols from the set of symbols that occur, relative to a last symbol of a PDSCH reception conveying a RAR message with a RAR UL grant on the target cell, after a number of symbols that is smaller than msec, where  is a time duration of  symbols corresponding to a PDSCH processing time for UE processing capability 1 when additional PDSCH DM-RS is configured,  is a time duration of  symbols corresponding to a PUSCH preparation time for UE processing capability 1 [6, TS 38.214] and the UE considers that  and  correspond to the smaller of the SCS configurations for the PDSCH on the target cell and the transmission on the source cell. For , the UE assumes  [6, TS 38.214]. |

* Proposal [6]: Consider reformulating the agreement to simply the interpretation. Remove the brackets around the time offsets.
	+ The following is the proposed TP:

### TP#1-5

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| --- |
| **15 Dual active protocol stack based handover**< Unchanged parts are omitted >If - the UE does not provide *UplinkPowerSharingDAPS-HO*, and - UE transmissions on the target cell and the source cell overlap the UE transmits only on the target cell the UE transmits only on the target cell, and cancels the transmission to source cell after the PUSCH preparation time *T*proc,2 for the corresponding PUSCH processing capability [6, TS 38.214] assuming *d*2,1 = 1 after a last symbol of a CORESET where the UE detects a DCI format scheduling the transmission on the target cell and *μ* corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format and the SCS configuration of the UE transmission on the source cell. If the UE transmits PRACH using 1.25 kHz or 5 kHz SCS on the source cell, the UE determines *T*proc,2 assuming SCS configuration *μ* = 0.The UE does not expect to cancel a transmission on the source cell the PUSCH preparation time *T*proc,2 for the corresponding PUSCH processing capability [6, TS 38.214] assuming *d*2,1 = 1 after a last symbol of a CORESET where the UE detects a DCI format scheduling the transmission on the target cell and *μ* corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format and the SCS configuration of the UE transmission on the source cell. If the UE transmits PRACH using 1.25 kHz or 5 kHz SCS on the source cell, the UE determines *T*proc,2 assuming SCS configuration *μ* = 0. |

* Proposal [8]:
	+ UL cancellation behaviour can be based simply to the defined timeline
	+ The following is the proposed TP:

### TP#1-6

|  |
| --- |
| If - the UE does not provide *UplinkPowerSharingDAPS-HO*, and - UE transmissions on the target cell and the source cell overlap the UE transmits only on the target cell, and cancels the transmission to source cell after the PUSCH preparation time *T*proc,2 for the corresponding PUSCH processing capability [6, TS 38.214] assuming *d*2,1 = 1 after a last symbol of a CORESET where the UE detects a DCI format scheduling the transmission on the target cell and μ corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format and the SCS configuration of the UE transmission on the source cell. If the UE transmits PRACH using 1.25 kHz or 5 kHz SCS on the source cell, the UE determines *T*proc,2 assuming SCS configuration *μ*=0. A UE does not expect to cancel a transmission to the source cell in symbols that occur, relative to a last symbol of a CORESET where the UE detects a DCI format scheduling a transmission on the target cell, after a number of symbols that is smaller than the PUSCH preparation time *T*proc,2 for the corresponding PUSCH processing capability [6, TS 38.214] assuming *d*2,1 = 1 and *μ* corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format and the SCS configuration of the UE transmission on the source cell. If the UE transmits PRACH using 1.25 kHz or 5 kHz SCS on the source cell, the UE determines *T*proc,2 assuming SCS configuration *μ*=0. |

## Issue #3) Overlapping UL transmission between source and target cells [1][2][4][5][8]

The issue for PRACH and PUSCH/PUCCH/SRS overlapping scenarios was discussed in RAN1 #100-E meeting. However, some companies have provided further input to the issue.

Contribution in [1] mentioned that that definition of overlapping slots for PRACH and PUSCH/PUCCH/SRS could be ambiguous when target and source cell are synchronized. Therefore, suggests updating the description.

* Proposed TP from [1]:

### TP#2-1

|  |
| --- |
| 15 Dual active protocol stack based handover<---------------------------Other parts are omitted ------------------------------->For DAPS operation in a same frequency band, a UE does not transmit PUSCH/PUCCH/SRS to the source MCG in a slot ~~when the transmission would~~ overlapping in time with a PRACH transmission to the target MCG or when a gap between a first or last symbol of a PRACH transmission to the target MCG in a first slot would be separated by less than $N$ symbols from a last or first symbol, respectively, of the PUSCH/PUCCH/SRS transmission to the source MCG in a second slot. $N=2$ for $μ=0$ or $μ=1$, $N=4$ for $μ=2$ or $μ=3$, and $μ$ is the SCS configuration of the active UL BWP for the PUSCH/PUCCH/SRS transmission to source MCG. |

Contribution in [2] noted that if the time gap between source and target cell PUSCH/PUCCH/SRS is too short UE may not be able to switch the transmissions, especially if UE is using the same RF chain to serve target and source cells.

 

**Figure from [2]: Gap between UL transmission to source MCG and UL transmission to target MCG**

* Proposed TP from [2]:

### TP#2-2

|  |
| --- |
| **<Unchanged parts are omitted>**For DAPS operation in a same frequency band, a UE does not transmit PUSCH/PUCCH/SRS to the source MCG in a slot when the transmission would overlap in time with a PRACH transmission to the target MCG or when a gap between a first or last symbol of a PRACH transmission to the target MCG in a first slot would be separated by less than $N$ symbols from a last or first symbol, respectively, of the PUSCH/PUCCH/SRS transmission to the source MCG in a second slot. $N=2$ for $μ=0$ or $μ=1$, $N=4$ for $μ=2$ or $μ=3$, and $μ$ is the SCS configuration of the active UL BWP for the PUSCH/PUCCH/SRS transmission to source MCG. For DAPS operation in a same frequency band, a UE does not transmit PUSCH/PUCCH/SRS to the source MCG in a slot when a gap between a first or last symbol of a PUSCH/PUCCH/SRS transmission to the target MCG in a first slot would be separated by less than $N$ symbols from a last or first symbol, respectively, of the PUSCH/PUCCH/SRS transmission to the source MCG in a second slot. $N=1$ for $μ=0$ or $μ=1$ or $μ=2$，$N=2$ for $μ=3$, and $μ$ is the SCS configuration of the active UL BWP for the PUSCH/PUCCH/SRS transmission to source MCG. |

Additionally, [4] and [5] mentioned the UE behaviour for when the UE needs to transmit PRACH in the source cell and PUSCH/PUCCH/SRS is missing from specification.

* Proposed TP from [4]:

### TP#2-3

|  |
| --- |
| 15 Dual active protocol stack based handover*< Unchanged parts are omitted >*For DAPS operation in a same frequency band, a UE does not transmit PUSCH/PUCCH/SRS to source MCG in a slot overlapping in time domain with PRACH transmission to target MCG or when a gap between the first or last symbol of a PRACH transmission to target MCG in a first slot is separated by less than *N* symbols from the last or first symbol, respectively, of a PUSCH/PUCCH/SRS transmission to source MCG in a second slot. *N* = 2 for *µ*=0 or *µ*=1,  *N*=4 for *µ*=2 or *µ*=3, and *µ* is the SCS configuration of the active UL BWP for PUSCH/PUCCH/SRS transmission to the source MCG.For DAPS operation in a same frequency band, a UE does not transmit PUSCH/PUCCH/SRS to target MCG in a slot overlapping in time domain with PRACH transmission to source MCG or when a gap between the first or last symbol of a PRACH transmission to source MCG in a first slot is separated by less than *N* symbols from the last or first symbol, respectively, of a PUSCH/PUCCH/SRS transmission to target MCG in a second slot. *N* = 2 for *µ*=0 or *µ*=1,  *N*=4 for *µ*=2 or *µ*=3, and *µ* is the SCS configuration of the active UL BWP for PUSCH/PUCCH/SRS transmission to the target MCG. |

* Proposed TP from [5]:

### TP#2-4

|  |
| --- |
| For DAPS operation in a same frequency band, a UE does not transmit PUSCH/PUCCH/SRS to the source MCG in a slot when the transmission would overlap in time with a PRACH transmission to the target MCG or when a gap between a first or last symbol of a PRACH transmission to the target MCG in a first slot would be separated by less than $N$ symbols from a last or first symbol, respectively, of the PUSCH/PUCCH/SRS transmission to the source MCG in a second slot. $N=2$ for $μ=0$ or $μ=1$, $N=4$ for $μ=2$ or $μ=3$, and $μ$ is the SCS configuration of the active UL BWP for the PUSCH/PUCCH/SRS transmission to source MCG.For DAPS operation in a same frequency band, a UE does not transmit PRACH to the source MCG in a slot when the transmission would overlap in time with a PUSCH/PUCCH/SRS transmission to the target MCG or when a gap between a first or last symbol of a PUSCH/PUCCH/SRS transmission to the target MCG in a first slot would be separated by less than $N$ symbols from a last or first symbol, respectively, of the PRACH transmission to the source MCG in a second slot. $N=2$ for $μ=0$ or $μ=1$, $N=4$ for $μ=2$ or $μ=3$, and $μ$ is the SCS configuration of the active UL BWP for the PUSCH/PUCCH/SRS transmission to target MCG. |

* Proposal in [8]:
	+ When PRACH transmission in source cell would be scheduled to occur in same slot or be separated by less than N symbols from PUSCH/PUCCH/SRS in target cell, UE is not required to transmit PRACH in source UL BWP.
	+ The following is proposed TP:

### TP#2-5

|  |
| --- |
| For DAPS operation in a same frequency band, a UE does not transmit PUSCH/PUCCH/SRS to the source MCG in a slot when the transmission would overlap in time with a PRACH transmission to the target MCG or when a gap between a first or last symbol of a PRACH transmission to the target MCG in a first slot would be separated by less than $N$ symbols from a last or first symbol, respectively, of the PUSCH/PUCCH/SRS transmission to the source MCG in a second slot. For DAPS operation in a same frequency band, a UE does not transmit PRACH in active UL BWP of source MCG in a same slot when the transmission would overlap in time with a PUSCH/PUCCH/SRS transmission to the target MCG or when a gap between the first or last symbol of a PUSCH/PUCCH/SRS transmission in active UL BWP of target MCG in a first slot is separated by less than $N$ symbols from the last or first symbol, respectively, of a PRACH transmission in active UL BWP of source MCG in a second slot. $N=2$ for $μ=0$ or $μ=1$, $N=4$ for $μ=2$ or $μ=3$, and $μ$ is the SCS configuration of the active UL BWP for the PUSCH/PUCCH/SRS transmission to source MCG. |

**Discussion Summary:**

The issues and text proposals made in the submitted contributions can be largely categorized into 3 groups.

**Group 1)** Clarification on whether uplink cancellation should be for partial transmission (in units of symbols) or for the whole transmission

* Approach A) partial transmission
	+ TP #1-1, TP#1-2
* Approach B) whole transmission
	+ TP#1-3

**Group 2)** Supporting uplink cancellation timeline behavior for Msg 3

* RAN1 should determine whether or not such behavior needs to be explicitly defined or not.
* If need to be define whether TP #1-4 is acceptable.

**Group 3)** Reformulation the existing agreed text for better readability

* It was mentioned that the agreed text is quite difficult to parse and read. Suggests some reformulation (e.g. using ‘after’ in the first paragraph and ‘before’ in the second paragraph.
* TP#1-5
	+ Feature lead note: may need to double check whether TP#1-5 is the intended text.
* Feature lead note: if the timeline boundary for determining when UE can perform cancellation and when UE does not expect to receive control signal is the same, the text proposal can be cleaned up. Therefore, FL suggests resolving Group 3 issue (reformulate for claritiy) after other issues have been resolved.

**Group 4)** clarification of overlapping to avoid ambiguity for synchronized source and target MCG scenarios

* RAN1 should determine whether TP#2-1 is acceptable or not.

**Group 5)** Providing a protection gap between source and target MCG transmissions

 

**Figure from [2]: Gap between UL transmission to source MCG and UL transmission to target MCG**

* RAN1 should determine whether specification should support UE behavior so that UE does not need to handle cases with too short time gap between source and target PUSCH/PUCCH/SRS transmissions. Huawei has mentioned that time gap between source and target cell PUSCH/PUCCH/SRS is too short UE may not be able to switch the transmissions, especially if UE is using the same RF chain to serve target and source cells.
* If agreeable, RAN1 should determine whether TP#2-2 is acceptable or not.

**Group 6)** handling PRACH transmission in source MCG that overlaps with PUSCH/PUCCH/SRS transmission in target MCG

* RAN1 should determine whether specification should support the UE behavior to handle PRACH transmission in source MCG that overlaps with PUSCH/PUCCH/SRS transmission in target MCG. If need to be handled, which TP among TP#2-3, 2-4, or 2-5 is acceptable.

Companies are encouraged to provide comments on the proposal above. Please note comments for Group 1, 2, and 3, and Group 4, 5, and 6 are split into two different comment tables below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Company Name | Group 1(prefer approach A/B) | Group 2(agree/disagree in principle) | Group 3(agree/disagree reformulation would help readability) | Comments |
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| Company Name | Group 4(agree/disagree) | Group 5(agree/disagree in principle) | Group 6(agree/disagree in principle) | Comments |
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# Conclusion of Email Discussion [101-e-NR-Mob-Enh-01]

**Summary of email discussion outcome:**

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# Reference

1. R1-2003330, “Remaining issues on NR mobility enhancements in physical layer,” ZTE
2. R1-2003506, “Remaining issues on DAPS-HO,” Huawei, HiSilicon
3. R1-2003676, “Remaining issues on Physical Layer Aspects for DAPS-HO,” MediaTek Inc.
4. R1-2003748, “Corrections to Physical layer aspects of NR mobility enhancement,” Intel Corporation
5. R1-2003890, “Remaining issues for NR Mobility Enhancement,” Samsung
6. R1-2004202, “Remaining issues on mobility enhancements,” Ericsson
7. R1-2004235, “On remaining issues on NR mobility enhancements,” Apple
8. R1-2004580, “Remaining physical layer aspects of dual active protocol stack based HO,” Nokia, Nokia Shanghai Bell
9. R1-2003331, “Discussion on FR2 mobility interruption enhancements,” ZTE
10. R1-2004148, “Remaining PHY aspects for CHO,” Huawei, HiSilicon
11. R1-2003747, “Issue Summary for NR Mobility Enhancements,” Moderator (Intel Corporation)