**3GPP TSG RAN WG1 Meeting #100bis-E R1-2002010**

**e-Meeting, April 20 – 30, 2020**

**Source: Moderator (Intel Corporation)**

**Title: Issue Summary for NR Mobility Enhancements**

**Agenda item: 7.2.9**

**Document for: Discussion**

# Introduction

In this contribution, we summarize all issues submitted on Rel-16 NR mobility enhancement WI for RAN1 #100bis-E meeting. Section 2 contain a summary of issues identified from contributions submitted to RAN1 #100bis-E [1] ~ [10]. The list of issues in Section 2 are **not** ordered in terms of criticalness/discussion priority.

# Summary of Issues Identified from Contributions

## Issue #1) PDCCH/PDSCH restrictions for DL DAPS-HO [1]

Proposal from [1] is to define a separate capability for UE that can process overlapping resources from source and target cell in intra-frequency DAPS HO. The motivation for introducing a new capability is not force certain UEs to be able to process DL signals that overlap in time and frequency resources, which can be difficult in some scenarios without SIC techniques. The following are the proposals made:

* Proposal 1 [1]: Restrict the minimum UE capability of DAPS-HO to FDMed simultaneous reception from source and target cells on overlapping OFDM symbols.
* Proposal 2 [1]: Introduce additional UE feature simultaneousRxOnOverlappedfreqAndtime to indicate the support of simultaneous reception from source and target cells on overlapped time and frequency resources.
* Adopt the following TP [1]:

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| **15 Dual active protocol stack based handover**  If a UE indicates a capability for dual active protocol stack based handover (DAPS HO), the UE can be provided with a source MCG and a target MCG.  The UE may expect to receive one PDCCH associated to one MCG to schedule one PDSCH, where the full scheduling information for receiving a PDSCH is indicated and carried only by the corresponding PDCCH.  If a UE does not indicate a capability *simultaneousRxOnOverlappedfreqAndtime* for simultaneous reception on overlapped frequency resources and is configured with a source MCG and a target MCG, the UE does not expect:   * the set of frequency resources provided by higher layer parameter *frequencyDomainResources* in a *ControlResourceSet* in a source MCG to overlap with the set of frequency resources provided by *frequencyDomainResources* in a *ControlResourceSet* in a target MCG and, * to receive a PDSCH scheduled by a corresponding PDCCH sent by the source MCG to be located in frequency resources overlapping with a PDSCH scheduled by a corresponding PDCCH sent by the target MCG.   If the PDCCHs that schedule corresponding PDSCHs are associated to different MCGs, the UE procedure for receiving the PDSCH upon detection of a PDCCH follows Clause 5.1 in [5, TS 38.214]. |

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

The DAPS-HO allows for UEs that support dynamic power sharing to drop (or cancel) transmissions of less-prioritized transmission, namely transmission from the source cell. However, UE may not be completely aware of the transmission collision of source and target until a specific time before the transmission is about to occur. This issue has been identified during RAN1 #99 and was not completely resolved. A note was captured as part of an agreement to allow investigation further into this issue.

Several companies have provided input on this issue. The following is a summary of proposals from contributions.

* Proposal [1]: For UL cancellation to source cell, the time interval between the end of scheduling DCI from target cell and the start of UL transmission to source cell should be at least Toffset symbols.
  + Toffset = Tproc,2, where Tproc,2 is determined according to Section 6.4 of TS 38.214, assuming d2,1 = 1, d2,2 = 0, µ corresponds to the smallest SCS between the SCS of the PDCCH in target cell and the SCS of the UL transmission to the target cell, and N2 corresponds to a PUSCH preparation time for UE processing capability 1 in Section 6.4 of TS 38.214.
  + The following is the proposed TP:

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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  If a UE indicates support of cancelling uplink transmission to the source MCG, the UE shall cancel an uplink transmission to source cell started from *Toffset* symbols after the end of PDCCH which schedules/triggers an uplink transmission to target cell that collides with the uplink transmission to source cell, where *Toffset* = *Tproc,2*, where *Tproc,2* is determined according to [6, TS 38.214] assuming *d2,1 = 1*, *d2,2**= 0*, *µ* corresponds to the smallest SCS between the SCS of the PDCCH and the SCS of the uplink transmission on the target cell, and *N2* corresponds to a PUSCH preparation time for UE processing capability 1 [6, TS 38.214]. |

* Proposal [2]: For collision between an ongoing UL transmission to one cell and an upcoming UL transmission to the other cell, no cancellation timeline is needed and when to stop source cell transmission in case of resource collision should be up to implementation.
* Proposal [3]: A UE does not expect to receive scheduling grant for transmission that requires cancelling a transmission for scenarios which UE cannot fully know overlapping of source and target cell transmission would happen in advance.
  + The following is proposed TP:

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| 15 Dual active protocol stack based handover *< Unchanged parts are omitted >*  UE transmissions on the target cell and the source cell overlap if they are in  - overlapping time resources if the carrier frequencies for the target MCG and the source MCG are intra-frequency and intra-band  - overlapping time resources and overlapping frequency resources if the carrier frequencies for the target MCG and the source MCG are not intra-frequency and intra-band  A UE does not expect to receive scheduling of a transmission that requires canceling the 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  for the corresponding PUSCH processing capability [6, TS 38.214] assuming  and  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  assuming SCS configuration .  A UE does not expect receive scheduling of a transmission that requires canceling the 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 [4] : The timeline based on Rel-15 uplink cancellation due to SFI (clause 11.1.1 of TS38.213) is more adequate for DAPS-HO. For the cancellation due to target cell msg3, we follows similar logic with the gap between msg2 and msg3 (clause 8.3 of TS38.213) to ensure enough processing time.
  + Uplink cancellation rule is applied to all UEs supporting DAPS-HO, including UEs provide no or semi-static power sharing capability. Asking a UE cannot do dynamic power sharing to follow a timeline based on other dynamic power sharing option feature does not make sense. This implies UplinkPowerSharingDAPS-HO=dynamic is mandated capability in DAPS-HO.
  + Depending on UE implementation, cancellation and power control may require different mechanism in the uplink transmission process. Also, T\_offset is still under discussion in NR/DC WI and it involves the time dealing with overlapping transmission among two cell groups. Since RAN2 already agreed DAPS HO involves only PCells in source and target cell, we are looking at two very different procedures here.
  + The following is the proposed TP:

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| 15 Dual active protocol stack based handover ----omitted----  UE transmissions on the target cell and the source cell overlap if they are in  - overlapping time resources if the carrier frequencies for the target MCG and the source MCG are intra-frequency and intra-band  - overlapping time resources and overlapping frequency resources if the carrier frequencies for the target MCG and the source MCG are not intra-frequency and intra-band  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  for the corresponding PUSCH processing capability [6, TS 38.214] assuming  and  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  assuming SCS configuration .  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].  ----omitted---- |

* Proposal [6]: After the UL cancellation schemes are completed, then to determine which scheme is adopted by DAPS HO.
  + For NR-DC based scheme, it is applied to UE with dynamic power sharing capability. To compute the transmission power for SCG UL transmission starting at time T0, the UE would check the PDCH received before the T0-T\_offset that trigger an overlapping MCG UL transmission. How to determine the T\_offset is still open. If the scheme is re-used, before the source cell transmit the UL, i.e., configured grant PUSCH or dynamic grant PUSCH, it would check the target cell PDCCH scheduled PUSCH whether it is colliding with source cell transmission.
  + For eURLLC based scheme, UL transmission cancellation timeline is defined, UE will cancel the low priority UL transmission starting from Tproc, 2+d1 after end of the last symbol of the PDCCH scheduling the high priority transmission. The minimum processing time of the high priority channel is Tproc,2 +d2. Current agreements only focus on the case that high priority dynamic grant PUSCH transmission is colliding with low priority PUSCH/PUCCH. If the scheme is re-used, for DAPS HO, the open issue is the timeline of PUCCH transmission to target cell colliding with the PUSCH/PUCCH transmission to the source cell.

## Issue #3) Single UL transmission for DAPS HO [2]

RAN2 is proposing to introduce a singleUL-Transmission capability. Contribution [2] discuss to add the corresponding physical layer specification that specifies the UE behavior when singleUL-Transmission capability is enabled. The following are proposal from [2]:

* Proposal [2]: If a UE indicates singleUL-Transmission, the UE transmits only the target cell if UL transmissions on the target cell and the source cell are in overlapping time resources during DAPS handover.
  + The following is the proposed TP:

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| 15 Dual active protocol stack based handover  <---------------------------Other parts are omitted ------------------------------->  If  - the UE indicates *singleUL-Transmission*, and  - UE transmissions on the target cell and the source cell are in overlapping time resources  the UE transmits only on the target cell.  Else i~~I~~f  - the UE does not ~~provide~~ *~~UplinkPowerSharingDAPS-HO~~*indicate *singleUL-Transmission*, and  ~~-~~ UE transmissions on the target cell and the source cell overlap  the UE transmits only on the target cell  UE transmissions on the target cell and the source cell overlap if they are in  - overlapping time resources if the carrier frequencies for the target MCG and the source MCG are intra-frequency and intra-band  - overlapping time resources and overlapping frequency resources if the carrier frequencies for the target MCG and the source MCG are not intra-frequency and intra-band  <---------------------------Other parts are omitted -------------------------------> |

## Issue #4) PRACH and PUSCH/PUCCH/SRS overlap [2][3][5]

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

Contribution in [2] 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 [2]:

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| 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 symbols from a last or first symbol, respectively, of the PUSCH/PUCCH/SRS transmission to the source MCG in a second slot. for or , for or , and is the SCS configuration of the active UL BWP for the PUSCH/PUCCH/SRS transmission to source MCG. |

Additionally, two companies [3] 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.

* Proposal [5]: 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:

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| 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 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 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 symbols from the last or first symbol, respectively, of a PRACH transmission in active UL BWP of source MCG in a second slot. for or , for or , and is the SCS configuration of the active UL BWP for the PUSCH/PUCCH/SRS transmission to source MCG. |

* Proposed TP from [3]:

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| 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. |

## Issue #5) Power Control for FR2 to FR2 DAPS [1]

RAN2 has agreed to not support FR2 to FR2 DAPS HO in Rel-16. The current specification is generically written such that it could be applied to FR2 to FR2 DAPS HO scenarios. Therefore, further clarification to was suggested by [1].

* Proposal [1]: Clarify possible configurations of frequency ranges for source and target MCGs and avoid misleading term of “and/or” in the description of UL power sharing.
  + The following is proposed TP:

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| **15 Dual active protocol stack based handover**  < Unchanged parts are omitted >  If a UE is configured with:   * a target MCG using NR radio access in FR1 and a source MCG using NR radio access in FR1, or * a target MCG using NR radio access in FR1 and a source MCG using NR radio access in FR2, or * a target MCG using NR radio access in FR2 and a source MCG using NR radio access in FR1,   the UE is configured a maximum power for transmissions on the target MCG and a maximum power for transmissions on the source MCG:   * by *p-DAPS-FR1* for the target MCG using NR radio access in FR1 and by *p-DAPS-FR1* for the source MCG using NR radio access in FR1, or * by *p-DAPS-FR1* for the target MCG using NR radio access in FR1 and by *p-DAPS-FR2* for the source MCG using NR radio access in FR2, or * by *p-DAPS-FR2* for the target MCG using NR radio access in FR2 and by *p-DAPS-FR1* for the source MCG using NR radio access in FR1,   and with an inter-CG power sharing mode by *UplinkPowerSharingDAPS-HO-mode* for the frequency range combination used by the source and target MCGs. The UE determines a transmission power on the target MCG and a transmission power on the source MCG per frequency range. |

## Issue #6) Power Sharing Mode for UL DAPS-HO [3][4][5][6][7][8]

Several companies provided discussion on how to correct the power sharing mode description for UL DAPS-HO. The following are list of proposals and corresponding TPs:

* Proposal [3] The indication from the gNB to UE to have the UE to no perform any power sharing operation and always drop the source cell transmission when it overlaps with target cell could be done by not providing the *UplinkPowerSharingDAPS-HO-mode* RRC configuration. Alternative method would be explicitly introducing a ‘no-powersharing mode’ indication for *UplinkPowerSharingDAPS-HO-mode*.
  + The following is proposed TP:

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| 15   Dual active protocol stack based handover *< Unchanged parts are omitted >*  If the UE does not provide ~~indicates~~ *UplinkPowerSharingDAPS-HO* ~~=~~ *~~Semistatic-mode1~~* and is provided *UplinkPowerSharingDAPS-HO-mode* = *Semi-static-mode1*, the UE determines a transmission power for the target MCG or for the source MCG as described in Clause 7.6.2 for *~~UplinkPowerSharingDAPS-HO~~NR-DC-PC-mode* = *Semi-static-mode1* by considering the target MCG as the MCG and the source MCG as the SCG.  If the UE does not provide ~~indicates~~ *UplinkPowerSharingDAPS-HO* ~~= Semistatic-mode2~~and is provided *UplinkPowerSharingDAPS-HO-mode* = *Semi-static-mode2*, the UE determines a transmission power for the target MCG or for the source SCG as described in Clause 7.6.2 for *~~UplinkPowerSharingDAPS-HO~~NR-DC-PC-mode* = *Semi-static-mode2* by considering the target MCG as the MCG and the source MCG as the SCG.  If the UE indicates *UplinkPowerSharingDAPS-HO* ~~= Dynamic~~and is provided *UplinkPowerSharingDAPS-HO-mode* = *Dynamic*, the UE determines a transmission power for the target MCG or for the source MCG as described in Clause 7.6.2 for *~~UplinkPowerSharingDAPS-HO~~NR-DC-PC-mode* = *Dynamic* by considering the target MCG as the MCG and the source MCG as the SCG.  If  -   the UE is not provided with ~~does not provides~~ *UplinkPowerSharingDAPS-HO-mode,* and  -   UE transmissions on the target cell and the source cell ~~overlap~~ are in overlapping time resources  the UE transmits only on the target cell |

* Two alternative TP are provided in [4]. The first alternative TP is proposed if the UE feature group 21-2 description is agreed with ALT 1 formulation (described in NTT Docomo’s contribution on UE feature list summary). The second alternative TP is proposed if the UE feature group 21-2 description is agreed with ALT 2 formulation.
  + ALT 1 formulation:

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| 15   Dual active protocol stack based handover *< Unchanged parts are omitted >*  If the UE does not provide ~~indicates~~ *UplinkPowerSharingDAPS-HO* ~~=~~ *~~Semistatic-mode1~~* and is provided *UplinkPowerSharingDAPS-HO-mode* = *Semi-static-mode1*, the UE determines a transmission power for the target MCG or for the source MCG as described in Clause 7.6.2 for *~~UplinkPowerSharingDAPS-HO~~NR-DC-PC-mode* = *Semi-static-mode1* by considering the target MCG as the MCG and the source MCG as the SCG.  If the UE does not provide ~~indicates~~ *UplinkPowerSharingDAPS-HO* ~~= Semistatic-mode2~~and is provided *UplinkPowerSharingDAPS-HO-mode* = *Semi-static-mode2*, the UE determines a transmission power for the target MCG or for the source SCG as described in Clause 7.6.2 for *~~UplinkPowerSharingDAPS-HO~~NR-DC-PC-mode* = *Semi-static-mode2* by considering the target MCG as the MCG and the source MCG as the SCG.  If the UE indicates *UplinkPowerSharingDAPS-HO* ~~= Dynamic~~and is provided *UplinkPowerSharingDAPS-HO-mode* = *Dynamic*, the UE determines a transmission power for the target MCG or for the source MCG as described in Clause 7.6.2 for *~~UplinkPowerSharingDAPS-HO~~NR-DC-PC-mode* = *Dynamic* by considering the target MCG as the MCG and the source MCG as the SCG.  If  -   the UE is not provided with ~~does not provides~~ *UplinkPowerSharingDAPS-HO-mode,* and  -   UE transmissions on the target cell and the source cell ~~overlap~~ are in overlapping time resources  the UE transmits only on the target cell  If  -   the UE is provided *UplinkPowerSharingDAPS-HO-mode*, and  -   UE transmissions on the target cell and the source cell overlap  the UE transmits only on the target cell  ----omitted---- |

* + ALT 2 formualtion:

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| 15 Dual active protocol stack based handover ----omitted----  If  -   the UE does not provide *UplinkPowerSharingDAPS-HO*, or is not provided *UplinkPowerSharingDAPS-HO-Mode* and  -   UE transmissions on the target cell and the source cell are in overlapping time resources  the UE transmits only on the target cell.  If  -   the UE ~~does not~~ provides *UplinkPowerSharingDAPS-HO*, and  -   UE transmissions on the target cell and the source cell overlap  the UE transmits only on the target cell  UE transmissions on the target cell and the source cell overlap if they are in  -   overlapping time resources if the carrier frequencies for the target MCG and the source MCG are intra-frequency and intra-band  -   overlapping time resources and overlapping frequency resources if the carrier frequencies for the target MCG and the source MCG are not intra-frequency and intra-band  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.  The UE determines intra-frequency as described in Clause 9.2.1 of [10, TS38.133].  ----omitted---- |

* Proposal [5] proposes to remove the *UplinkPowerSharingDAPS-HO* capability parameter description and replaces it with statement if which power control mode is used.
  + The following is the proposed TP:

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| If the UE indicates capability for *~~UplinkPowerSharingDAPS-HO~~* ~~=~~ *Semistatic-mode1* power sharing and is provided *UplinkPowerSharingDAPS-HO-mode* = *Semi-static-mode1*, the UE determines a transmission power for the target MCG or for the source MCG as described in Clause 7.6.2 for *~~UplinkPowerSharingDAPS-HO~~NR-DC-PC-mode* = *Semi-static-mode1* by considering the target MCG as the MCG and the source MCG as the SCG.  If the UE indicates capability for *~~UplinkPowerSharingDAPS-HO~~* ~~=~~ *Semistatic-mode2* power sharing and is provided *UplinkPowerSharingDAPS-HO-mode* = *Semi-static-mode2*, the UE determines a transmission power for the target MCG or for the source SCG as described in Clause 7.6.2 for *~~UplinkPowerSharingDAPS-HO~~NR-DC-PC-mode* = *Semi-static-mode2* by considering the target MCG as the MCG and the source MCG as the SCG.  If the UE indicates capability for*~~UplinkPowerSharingDAPS-HO~~* ~~=~~ *Dynamic* power sharing and is provided *UplinkPowerSharingDAPS-HO-mode* = *Dynamic*, the UE determines a transmission power for the target MCG or for the source MCG as described in Clause 7.6.2 for *~~UplinkPowerSharingDAPS-HO~~NR-DC-PC-mode* = *Dynamic* by considering the target MCG as the MCG and the source MCG as the SCG.  If  - the UE is~~does~~ not provided *UplinkPowerSharingDAPS-HO-mode*, and  - UE transmissions on the target cell and the source cell overlap  the UE transmits only on the target cell  UE transmissions on the target cell and the source cell overlap if they are in  - overlapping time resources if the carrier frequencies for the target MCG and the source MCG are intra-frequency and intra-band  - overlapping time resources and overlapping frequency resources if the carrier frequencies for the target MCG and the source MCG are not intra-frequency and intra-band |

* Proposal [6]: If gNB doesn’t configure the parameter UplinkPowerSharingDAPS-HO-mode, then no simultaneous UL transmission is allowed for UE with or without simultaneous transmission capability. UE drop the transmission to source cell if transmission collide in time domain resources. If gNB configures the parameter UplinkPowerSharingDAPS-HO-mode to UE with simultaneous transmission capability, if transmissions collide for intra-frequency intra-band and inter-frequency intra-band DAPS HO, then UE drops the transmission to source cell.
  + The following the proposed TP:

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| 15 Dual active protocol stack based handover  If  - the UE is not provided with *UplinkPowerSharingDAPS-HO-mode* , and  - UE transmissions on the target cell and the source cell are overlapping in time resources  Or if  - the UE is ~~does not~~ provided with *UplinkPowerSharingDAPS-HO-mode*, and  - UE transmissions on the target cell and the source cell overlap  the UE transmits only on the target cell  UE transmissions on the target cell and the source cell overlap if they are in  - overlapping time resources if the carrier frequencies for the target MCG and the source MCG are intra-frequency and intra-band  - overlapping time resources and overlapping frequency resources if the carrier frequencies for the target MCG and the source MCG are not intra-frequency and intra-band  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. |

* Proposal [7]: If the NW does not signal to the UE how to distribute the transmit power between source and target, i.e., if the UE is not provided with the RRC parameter UplinkPowerSharingDAPS-HO-mode, the UE drops any UL transmission to the source if it overlaps with an UL transmission to target.
  + The following the proposed TP:

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| 15 Dual active protocol stack based handover  If  - the UE does not provide *UplinkPowerSharingDAPS-HO,* or is not provided *UplinkPowerSharingDAPS-HO-mode*, and  - UE transmissions on the target cell and the source cell overlap  the UE transmits only on the target cell. |

* Proposal [8]: Change UplinkPowerSharingDAPS-HO in “… as described in Clause 7.6.2 for UplinkPowerSharingDAPS-HO …” to NR-DC-PC-mode. Furthermore, we should align the terminology for Semi-static mode i.e., changing “Semistatic-mode” to “Semi-static-mode”.
  + Note: similar to proposal in [5]
  + The following the proposed TP:

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| **15 Dual active protocol stack based handover**  <unchanged text omitted>  If the UE indicates *UplinkPowerSharingDAPS-HO* = *Semi-static-mode1* and is provided *UplinkPowerSharingDAPS-HO-mode* = *Semi-static-mode1*, the UE determines a transmission power for the target MCG or for the source MCG as described in Clause 7.6.2 for *NR-DC-PC-mode* = *Semi-static-mode1* by considering the target MCG as the MCG and the source MCG as the SCG.  If the UE indicates *UplinkPowerSharingDAPS-HO* = *Semi-static-mode2* and is provided *UplinkPowerSharingDAPS-HO-mode* = *Semi-static-mode2*, the UE determines a transmission power for the target MCG or for the source SCG as described in Clause 7.6.2 for *NR-DC-PC-mode* = *Semi-static-mode2* by considering the target MCG as the MCG and the source MCG as the SCG.  If the UE indicates *UplinkPowerSharingDAPS-HO* = *Dynamic* and is provided *UplinkPowerSharingDAPS-HO-mode* = *Dynamic*, the UE determines a transmission power for the target MCG or for the source MCG as described in Clause 7.6.2 for *NR-DC-PC-mode* = *Dynamic* by considering the target MCG as the MCG and the source MCG as the SCG.  <unchanged text omitted> |

## Issue #7) Overbooking of PDCCH monitoring in DL DAPS-HO [3][5]

Two company mentioned that the overbooking rules for DAPS-HO is more stringent than what was agreed in RAN1 #99 and suggests changing the specification to limit the overbooking in the target MCG only.

* Text Proposal from [3][5]:

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| 15 Dual active protocol stack based handover *< Unchanged parts are omitted >*  The UE can provide *pdcch-BlindDetectionMCG1-UE* to indicate a capability to monitor a maximum number of PDCCH candidates per slot that corresponds to downlink cells for the target MCG and *pdcch-BlindDetectionMCG2-UE* to indicate a capability monitor a maximum number of PDCCH candidates per slot that corresponds to downlink cells for the source MCG. If the UE is provided search space sets on both the target MCG and the source MCG, the UE does not expect to have in any slot any USS set without allocated PDCCH candidates for monitoring on ~~both~~ the target MCG ~~and the source MCG~~. |

## Issue #8) Collision for inter-frequency intra-band DAPS HO [4]

One company [4] mentioned that overlapping condition for intra-band inter-frequency case may not be possible based on RAN2 #109-E agreement for inter-FreqDAPS capability signaling. The following is the RAN2 agreement:

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| For inter freq DAPS, the capability inter-FreqDAPS is specified per BC (for intra band, inter band cases). .It is put under existing CA bandcombiantion, and same as CA, the CCs in the bandcombination with UL can all be source or target PCell. |

* Based on this proposes the following TP:

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| 15 Dual active protocol stack based handover ----omitted----  UE transmissions on the target cell and the source cell overlap if they are in  - overlapping time resources if the carrier frequencies for the target MCG and the source MCG are intra-frequency and intra-band  ~~- overlapping time resources and overlapping frequency resources if the carrier frequencies for the target MCG and the source MCG are not intra-frequency and intra-band~~  ----omitted---- |

## Issue #9) Physical layers aspects for CHO [9]

One company has provided few observations regarding conditional HO and its impact to physical layer specification. The following are the observations and proposal made based on the observation:

* Observation 1 [9]: Reporting events for HO are triggered using cell-level results obtained from beam measurements, which are L3-filtered and evaluated against a certain threshold for a time configured for a given event.
* Observation 2 [9]: In FR2, a UE will have to do beam sweeping in order to find the appropriate Rx beam in order to detect and measure a given RS for mobility purposes per the current procedure in Rel-15.
* Proposal [9]: Do not further discuss RAN1 impact for CHO in Rel-16.

## Issue #10) FR2 mobility interruption enhancements [10]

One company has provided several observations on the FR2 mobility interruption enhancement and its applicability for Rel-16. The following are the observations and proposal made based on the observation:

* Observation 1 [10]: DAPS handover is not supported for handover from FR2 to FR2 in Rel-16.
* Observation 2 [10]: For UL transmission during DAPS handover in Rel-16, power sharing mechanism is used when simultaneous transmission is feasible and a TDM-ed transmission manner is used for UEs without a capability of simultaneous transmission.
* Observation 3 [10]: The current UL transmission method during DAPS handover can be reused in DAPS handover in FR2 very well and there is no additional problem in RAN1.
* Observation 4 [10]: If a UE cannot support simultaneous reception in FR2, a TDM manner can be used, which is similar to TDM-ed UL transmission during DAPS handover in Rel-16.
* Observation 5 [10]: TDM-ed transmission and reception can be easily achieved by scheduling in NR.
* Observation 6 [10]: The potential RAN1 specification impact is to add a dropping rule for DL reception for UE during DAPS handover.
* Proposal [10]: Consider extending DAPS to support handover in FR2 in the future release.

## Issue #11) UE Capability Related issues [1]

As part of the discussion for physical layer issues for DAPS, one company provided discussion on introduction of new UE feature and how to formulate the interpretation when specific UE capability is not provided by the UE. These proposals and aspects can be discussed as part of UE feature discussion in Agenda 7.2.11.

* Proposal 2 [1]: Introduce additional UE feature simultaneousRxOnOverlappedfreqAndtime to indicate the support of simultaneous reception from source and target cells on overlapped time and frequency resources.
* Proposal 5 [1]: UE indication of support for FG 21-2 without indicating support for FG 21-2a implies the support of DAPS-HO with simultaneous UL transmission capability.

# Reference

1. R1-2001530, “Remaining issues on DAPS-HO,” Huawei, HiSilicon
2. R1-2001624, “Remaining issues on NR mobility enhancements in physical layer,” ZTE
3. R1-2002011, “Corrections to Physical layer aspects of NR mobility enhancement,” Intel Corporation
4. R1-2002148, “Remaining issues for NR Mobility Enhancement,” Samsung
5. R1-2002221, “Remaining physical layer aspects of dual active protocol stack based HO,” Nokia, Nokia Shanghai Bell
6. R1-2002344, “On remaining issues on NR mobility enhancements,” Apple
7. R1-2002490, “Correction to UL power sharing for DAPS HO,” Ericsson
8. R1-2002558, “Maintenance for NR mobility enhancements,” Qualcomm Incorporated
9. R1-2001531, “Remaining PHY aspects for CHO,” Huawei, HiSilicon
10. R1-2001625, “Discussion on FR2 mobility interruption enhancements,” ZTE