**3GPP TSG RAN WG1 Meeting #100bis-E R1-200xxxx**

**e-Meeting, April 20 – 30, 2020**

**Source: Moderator (Intel Corporation)**

**Title: Summary of email discussions for NR Mobility Enhancements**

**Agenda item: 7.2.9**

**Document for: Discussion**

# Introduction

In this contribution, we summarize the email discussion approved for discussion during RAN1 #100bis-E. Chairman has approved three email discussion threads for RAN1 #100bis-E. The following are the approved email discussions:

* [100b-e-NR-Mob-Enh-01] Email discussion/approval on UL cancellation in UL DAPS-HO by 4/24; if necessary, followed by endorsing the corresponding TP by 4/30 – Daewon (Intel)
* [100b-e-NR-Mob-Enh-02] Email discussion/approval on power sharing mode for UL DAPS-HO by 4/23; if necessary, followed by endorsing the corresponding TP by 4/29 – Daewon (Intel)
* [100b-e-NR-Mob-Enh-03] Email discussion/approval on PDCCH/PDSCH restrictions for DL DAPS-HO by 4/22; if necessary, followed by endorsing the corresponding TP by 4/28 – Daewon (Intel)

# Email Discussion [100b-e-NR-Mob-Enh-01]

[Copy discussion from the document for email thread-01]

# Email Discussion [100b-e-NR-Mob-Enh-02]

This discussion is regarding the power Sharing Mode for UL DAPS-HO (Issue #6 from [11]).

**Issue and Proposal Summary:**

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 by Intel [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 resourcesthe UE transmits only on the target cell  |

* Two alternative TP are provided by Samsung [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 resourcesthe UE transmits only on the target cellIf -   the UE is provided *UplinkPowerSharingDAPS-HO-mode*, and -   UE transmissions on the target cell and the source cell overlapthe UE transmits only on the target cell ----omitted---- |

* + ALT 2 formulation:

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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 overlapthe 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-bandFor 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 by Nokia [5]: suggests 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 by Apple [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-bandFor 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 by Ericsson [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 by Qualcomm [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> |

**Discussion Summary:**

Companies are encouraged to provide comments on the proposal above. Comments should include views on whether proposal by Intel [3], Samsung [4], Nokia [5], Apple [6], Ericsson [7], and/or Qualcomm [8] is/are acceptable or not. Also, if companies have a merged proposal based on proposal from above companies, please do provide them below as well.

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| Company Name | Comments/Views |
| Huawei/HiSilicon | The basic question, to our understanding, is whether there is correlation between UE indicates the capability of simultaneous transmission and does NOT indicate any power sharing mode. Our answer is yes. If UE is about to transmit UL simultaneously, similar to NR-DC, semi-static power sharing mode 1 should a basic feature. Otherwise, “no power sharing” would be meaningless. It is different from NW making decision whether enable/disable power sharing or simultaneous transmission. For example, if UE is not provided any power sharing mode, UE can just drop transmission to source cell.  |
| Ericsson | In our understanding, two issues are discussed in parallel: the NWs ability to configure the UE to always transmit to target (and drop source if needed), and how to define the UE capability of power sharing.Again in our understanding, there seems to wide agreement that if the NW does not provide *UplinkPowerSharingDAPS-HO-mode* the UE would only transmit to target in case of collision.Regarding the issue on how to define the capability, the technical difference among the proposals seem small, and could be discussed on the UE capability threads. |
| Qualcomm | Below we provide suggested TP merging several TPs. In addition, we would like to add UE behavior for the case that the UE is provided *UplinkPowerSharingDAPS-HO-mode* different from *UplinkPowerSharingDAPS-HO* that the UE provides e.g., UE provides *UplinkPowerSharingDAPS-HO* = *Semi-static-mode1* but it is provided with *UplinkPowerSharingDAPS-HO-mode* = *Dynamic.* Althoughthis could be an error case, UE behavior should be well-specified in the spec.One question somewhat related to Samsung’s TP for Alt.2 “The UE determines intra-frequency as described in Clause 9.2.1 of [10, TS38.133].”: we have “if the carrier frequencies for the target MCG and the source MCG are intra-frequency and intra-band”. Does “intra-frequency and intra-band” mean intra-frequency case only, or mean both intra-frequency case and inter-frequency intra-band case? If it is former case, I wonder why we need to include intra-band here since intra-frequency by its own is already intra-band?**Qualcomm’s suggested 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.If - the UE does not provide *UplinkPowerSharingDAPS-HO,* or is not provided *UplinkPowerSharingDAPS-HO-mode*, or is provided *UplinkPowerSharingDAPS-HO-mode* different from *UplinkPowerSharingDAPS-HO* that the UE provides, and - UE transmissions on the target cell and the source cell are in overlapping time resourcesthe UE transmits only on the target cell.If -   the UE provides *UplinkPowerSharingDAPS-HO*, and -   UE transmissions on the target cell and the source cell overlapthe UE transmits only on the target cell <unchanged text omitted> |

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| Intel | Quick question on the proposed TP from Qualcomm (above).The last text seems to be bit strange.“If -   the UE provides *UplinkPowerSharingDAPS-HO*, and -   UE transmissions on the target cell and the source cell overlapthe UE transmits only on the target cell”This states that if the UE has indicated a capability and transmissions overlap, then it should only transmit on the target cell (regardsless of anything else). I think this may be updated similarly to what Apple suggested. |
| Samsung | We support the suggested TP from Qualcomm’s input. (above or modified version in the follow-up email).Regarding Qualcomm’s clarification about “intra-frequency and intra-band”, we think it is clear that “intra-frequency and intra-band” means intra-frequency case only. And “intra-band” can be removed in the text Qualcomm refers to. |
| ZTE | In our understanding, one of reason for UE to always drop source cell transmission in case of UL collision is that UE does not support any power sharing, i.e. nothing is reported by UE for power sharing. The other reason is that single Tx is reported as discussed in our contribution. There may be some other reasons which leads to drop source cell transmission. So we are agree that all the cases can be merged to one that the network configures UE to drop source transmission. This can be indicated by the absence of UL power sharing mode. So, we support Apples’s TP.For the description of power sharing reporting in TS38.213, we think these can be fixed after the relevant UE reporting is finished.  |
| Nokia | Like noted in our paper, the principle should be that the UE behavior should be dependent on the network configuration and not vice versa. Of course if UE does not support certain functionality, network should not configure such functionality for the UE. Hence, regardless whether UE supports given power sharing mode(s), if NW does not configure any mode in use for the UE, UE should do the cancellation. Now based on the agreements the approach in my understanding was that when there is no collision (as per overlap definition), there should always be some power sharing mechanism in use, and this can of course be clarified pending on the UE FG discussion |
| MTK | After reading through all the agreements, we find QC’s proposal most clear and match current RAN1 agreements, so **we support QC’s suggested TP**. One small suggestion is that we can do the following change:*< Unchanged parts from QC’s TP are omitted >*If -   the UE provides *UplinkPowerSharingDAPS-HO*, and -   UE transmissions on the target cell and the source cell ~~overlap~~collidethe UE transmits only on the target cell UE transmissions on the target cell and the source cell ~~overlap~~collide 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-bandto match the wording in RAN1 #99 agreement:**Agreement:*** Confirm WA from RAN1 #98bis on UL transmission of signals/channels for DAPS HO with the following changes:
	+ Collision (in above) is defined for the following cases:
		- physical time resources for UL channel/signals partially or fully overlap for the intra-frequency intra-band scenario.
		- physical time and frequency resources for UL channel/signals partially or fully overlap in time and frequency for any other scenario.
 |

**Feature lead observation and summary (based on feedback received until 4/22 3pm UTC-7):**

* Companies seemed to be generally well aligned in views.
* The slight difference in views is whether the configured power sharing mode has any dependency on reported UE capability for power sharing.
* FL suggest agreeing on the common principles and iron out the exact TP.
	+ We can discuss further on how to capture the behavior for error cases, with the assumption that gNB should not configure power sharing modes that the UE does not support (or did not indicate altogether)

**Suggested Agreement:**

* gNB will have the ability to enable specific power sharing mode for DAPS including enabling no power sharing between target and source MCG (i.e. always drop source cell when overlapping).
	+ It is assumed that gNB shall only enable a power sharing mode for DAPS among the power sharing modes that the UE indicated support of.
	+ no power sharing between target and source MCG (i.e. always drop source cell when overlapping) can be indicated by gNB not configuring *UplinkPowerSharingDAPS-HO-mode*.

The following are 2nd round of comments and input on the above summary and suggested agreement:

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| Company Name | Comments/Views |
| Samsung | We support most of summary and listed agreements above.However, we suggest to add one additional bullet under the agreements, which seems mostly aligned from companies’ views:- Additional TP modification will also be introduced to align the previous agreement and the spec regarding UE dropping behavior on time overlapping allocations when power sharing is not utilized. |
| Qualcomm | We suggest the following change to the suggested agreements:* gNB ~~will have the ability to enable~~ can configure specific power sharing mode for DAPS including enabling no power sharing between target and source MCG (i.e. always drop source cell when overlapping).
	+ It is assumed that gNB shall only enable a power sharing mode for DAPS among the power sharing modes that the UE indicated support of.
	+ no power sharing between target and source MCG (i.e. always drop source cell when overlapping) can be indicated by gNB not configuring *UplinkPowerSharingDAPS-HO-mode*.
 |
| Apple | For UE without power sharing capability, we had the following agreements, so I think the discussion will be focusing on the UE with the power sharing capability.* If UE supporting DAPS HO indicates that UE is not capable of supporting simultaneous UL transmission to source and target cell, UE will drop transmission of source cell if UL transmissions of source and target cell overlap in time. Otherwise, UE transmits UL signals/channels to both source and target cell in DAPS HO.

We suggest the following change to the suggested agreements on top of Qualcomm’s comments:* For UE indicated the power sharing capability, gNB ~~will have the ability to enable~~ can configure specific power sharing mode for DAPS including enabling no power sharing between target and source MCG (i.e. always drop source cell when overlapping).
	+ It is assumed that gNB shall only enable a power sharing mode for DAPS among the power sharing modes that the UE indicated support of.
	+ no power sharing between target and source MCG (i.e. always drop source cell when overlapping) can be indicated by gNB not configuring *UplinkPowerSharingDAPS-HO-mode*.
 |
| Huawei/HiSilicon | Power sharing capability is under discussion in parallel. For example, one possibility is that UE supports semi-static mode 1 by default but not additionally indicates a power sharing mode, so the suggested agreement works in principle. We would like to make the following suggestions to polish the suggested agreement:* gNB ~~will have the ability to enable~~ can configure a specific power sharing mode for DAPS including enabling no power sharing between target and source MCG (i.e. always drop source ~~cell when overlapping~~ UL transmission in case of collision).
	+ It is assumed that gNB shall only enable a power sharing mode for DAPS among the power sharing modes thaSt the UE indicated support of.
	+ no power sharing between target and source MCG (i.e. always drop source ~~cell when overlapping~~ UL transmission in case of collision) ~~can be~~ is indicated by gNB not configuring *UplinkPowerSharingDAPS-HO-mode*.

Regarding Samsung’s request to add an additional bullet to make a TP regarding UE dropping behaviour: it is our understanding that we will first settle on the FL’s suggested agreement, and then we will proceed as per the FL’s recommendation and iron out the TP based on the finalized agreement. |

# Email Discussion [100b-e-NR-Mob-Enh-03]

[Copy discussion from the document for email thread-03]

# 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
11. R1-2002010, “Issue Summary for NR Mobility Enhancements,” Moderator (Intel Corporation)