3GPP TSG-RAN WG1 Meeting #102-e Tdoc R1-20xxxxx

Online, August 17th- 28th 2020

Agenda Item: 5

Source: Moderator (Ericsson)

Title: Email discussion on LTE DAPS power sharing week2

Document for: Discussion

# 1 Background

In R1-2005211, RAN2 sent an LS to RAN1 asking the following questions related to DAPS:

RAN2 asks RAN1:

1. Whether LTE DC uplink power sharing mechanism (i.e., mode 1 and mode 2) is applicable for both intra and inter frequency LTE DAPS HO?
2. If specified, RAN2 requests RAN1 to provide a list of UL power sharing parameters to be used for LTE DAPS HO.

The question is related to the LTE\_feMob WI, where RAN2 specified dual active protocol stack for LTE. RAN1 has only worked with DAPS for NR, where the corresponding functionality is still being completed in 38.213.

# 2 Discussion

DAPS handover is in many ways similar to dual connectivity. RAN1 used this resemblance when DAPS was specified for NR. In particular, the power sharing functionality specified for NR DAPS between source MCG and target MCG is very similar to the power sharing functionality specified for NN DC. For LTE, RAN2 seems to suggest that RAN1 uses this similarity to support also DAPS for LTE.

First, the following observation needs to be made:

1. The current RAN1 specifications do not support LTE DAPS.

For example, there is no text in RAN1 specification describing how the UE would share power between two MCGs.

Thus, to support DAPS for LTE, the RAN1 specifications would have to be amended, preferably relying on the power sharing functionality for LTE dual connectivity. Depending on how RAN1 responds to the RAN2 LS, RAN1 may also have to update 36.213. Once RAN1 has decided on the required update of 36.213, it would seem straightforward to agree on the content of the LS:

1. If there is agreement on the changes required in 36.213, providing a response LS would be straightforward.

Therefore, the moderator proposes to first discuss if RAN1 should amend 36.213 to support LTE DAPS.

## 2.1 Summary of input contributions

There were three discussion papers submitted ([1][3][4]) , and two draft LS responses ([1][2][5]) submitted

In [1], Qualcomm proposes to support LTE DAPS, and introduce support for UL power sharing in 36.213. Inter-band DAPS power sharing would follow the same mechanism as DC power sharing, whereas for intra-band synchronous DAPS, power control mode 1 can be applied. The corresponding text proposal is:

**<TP, 36.213 (new clause)>**

5.1.4a(new) Power allocation for dual active protocol stack

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.

If a UE is configured with a target MCG and a source MCG in different bands, and the UE is configured with *PowerCoordinationInfo-DAPS*, the UE shall apply the procedures described in clause 5.1.4 with the following modifications

 - Consider the target MCG as the MCG and the source MCG as the SCG.

 - Replace “(a)synchronous dual connectivity” by “(a)synchronous DAPS”.

If a UE is configured with a target MCG and a source MCG in the same band, and the UE is configured with *PowerCoordinationInfo-DAPS*, only synchronous DAPS as defined in [X] is applicable. The UE shall apply the procedures described in clause 5.1.4 with the following modifications

 - Consider the target MCG as the MCG and the source MCG as the SCG.

 - Replace “(a)synchronous dual connectivity” by “(a)synchronous DAPS”.

In [3], ZTE proposes to support LTE DAPS, and to introduce support for UL power sharing for inter-frequency DAPS. ZTE also proposes not to support UL power sharing for intra-frequency DAPS. ZTE proposes to add the following text at the very end of subclause 5.1.4 in 36.213:

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. If a UE is configured with a source MCG and a target MCG, the UE is configured with an inter-CG power control mode for inter-frequency handover by higher layer parameter *powerControlMode-DAPS* and a parameterfor determining power allocation for target MCG by higher layer parameter *p-DAPS-MeNB* and a parameter  for determining power allocation for source MCG by higher layer parameter *p-DAPS-SeNB*.

- If the higher layer parameter *powerControlMode-DAPS* indicates dual connectivity power control mode 1, the UE determines a transmission power for the target MCG or for the source MCG as described in this subclause for higher layer parameter *powerControlMode* indicating dual connectivity power control mode 1 by considering the target MCG as the MCG and the source MCG as the SCG.

- If the higher layer parameter *powerControlMode-DAPS* does not indicate dual connectivity power control mode 1, the UE determines a transmission power for the target MCG or for the source SCG as described in this subclause for higher layer parameter *powerControlMode* not indicating dual connectivity power control mode 1 by considering the target MCG as the MCG and the source MCG as the SCG.

In [4], Huawei proposes that LTE DAPS is not supported. Huawei mentions that issues related to how power sharing would be implemented, now overlapping transmissions are handled, and issues related to UE capabilities. Huawei remarks that these issues have been discussed at length in RAN1 for NR DAPS, and that the discussion is still not over.

# 3 Discussion points

As previously noted, RAN1 would need to agree to amend 36.213 in order to provide a positive response to the questions in the RAN2 LS. As there are not yet any agreements in RAN1 to introduce UL power sharing in LTE DAPS, it would seem appropriate to agree to support such power sharing, before discussing the content of the LS response.

Therefore, the moderator would like to know companies’ opinions on the following question:

**Q1. Should RAN1 introduce support for UL power sharing for LTE DAPS in 36.213?**

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| **Company** | **Input** |
| Huawei, HiSilicon | One comment on the observation 1 from the moderator: We tend to think observation 1 is not true….. I’d say spec is complete including RAN1 for LTE DAPS with simultaneous reception and uplink transmissions TDM-ed. UL power sharing is optimization to enable simultaneous transmission. Even though in NR DAPS, both simultaneous transmissions and uplink power sharing are UE capabilities. As noted in our discussion paper, we would like better to understand some issues related before we agree on “yes or no” for this question. Whether UE is mandated to support power sharing, whether simultaneous transmission is up to UE capability reporting, the relation between simultaneous transmission and UE power sharing, what UE behavior is if it is UE capability reporting but UE does not indicate the support, Whether NW can enable/disable the power sharing functionality, etc.  |
| **Qualcomm** | Yes, RAN1 should introduce support for UL power sharing by reusing DC power control (as seen in [1], [3], the changes are very contained).In our understanding, the details (capability/configuration) have been already decided by RAN2, e.g. in the latest version of TS 36.300 we can find the following capabilities (so, it should be clear that RAN1 spec alignment is needed):4.3.5.41 *intraFreqMultiUL-TransmissionDAPS-r16*This field indicates whether the UE supports simultaneous UL transmission in source PCell and intra-frequency target PCell.4.3.5.44 *interFreqMultiUL-TransmissionDAPS-r16*This field indicates whether the UE supports simultaneous UL transmission in source PCell and inter-frequency target PCell. |
| **Nokia, Nokia Shanghai Bell** | No. In the LTE DAPS HO LS R1-1913686 from RAN1 to RAN2 it was concluded that network based TDM is feasible. We think that power sharing mechanisms are not necessary. Potential collisions between transmissions to source and target cell can be handled by prioritizing transmission to the target cell. Our understanding is that LTE DC is defined only for inter-band operation, and DC based approach would be just partial solution for the problem. We think that the only thing that could be defined in RAN1 specifications is that for DAPS HO, UL transmission to target cell are prioritized. |
| **ZTE** | Yes for LTE inter-frequency DAPS handover.As noted by Qualcomm above, there is already capabilities defined in RAN2. So, UL power sharing by reusing DC power control mechanism can be considered.On the other hand, simultaneous transmission would be much difficult in intra-frequency case. It is not supported even in NR DAPS handover. So, for intra-frequency DAPS handover, we think TDMed transmission can be applied. In case of UL transmissions overlapping in the time domain, the same mechanism in NR intra-frequency DAPS handover by canceling the source cell transmission can be considered.  |
| **MTK** | To our understanding, RAN2 has agreed to introduce power coordination between source and target node for DAPS handover in LTE in RAN2#109e:* **Agreement**: For LTE, the DAPS network coordination is based on source link configuration to be used during DAPS HO, UE capabilities, maxSCH-TB-BitsDL, maxSCH-TB-BitsUL, **powerCoordinationInfo** within HandoverPreparationInformation message;

In NR DAPS, RAN1 defined power sharing as optional capability and also defined the relation between power sharing capability and UL cancellation capability. We think similar framework can be considered to be used for LTE DAPS HO as power sharing provides better UL efficiency. |
| **Google** | Yes, RAN1 should introduce support for UL power sharing for LTE DAPS in 36.213.From our perspective, we don’t see any critical concern on adopting UL power sharing to LTE DAPS HO. With TDMed solution has already supported in Rel.16 as a baseline, we can solve problems in a similar way as specified in NR-DC, and discuss whether the power sharing is madatory or not later. So, if there is no critical issue, and RAN2 has already agreed to support it, we should respect to RAN2’s decision.  |

If there is consensus in RAN1 to introduce UL power sharing for DAPS, RAN1 would need to agree on a suitable TP.

Based on the input of Q1, RAN1 would also formulate a response to the LS.

# 3 Discussion after August 21st

After the first week of discussion, there are indications that companies are willing to continue the discussion in order to specify UL power sharing for LTE DAPS, at least for inter-band operation, assuming that some details can be clarified. Looking back at the specification of NR DAPS, it is clear that the more difficult issues must be avoided. Based on the small amount of time, and on the input received so far, the moderator has tried to formulate proposals corresponding to a minimum implementation of UL power sharing for LTE DAPS.

The following moderator proposals are provided:

1. UL power sharing for LTE DAPS in supported for inter-band operation.

Since we limit this to inter-band operation, we avoid the issues related to intra-frequency that were heavily discussed for NR DAPS. Obviously, this would limit the scenarios where UL power sharing can be used. For other scenarios, the NW must ensure the transmission do not overlap.

Please express your views about the above proposal. Also comment about if the limitation to inter-band is acceptable.

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| Company | Comment |
| Ericsson | OK with the proposal. It is acceptable to limit to inter-band |
| Qualcomm | OK with the proposal |
| Huawei/HiSilicon | As noted by the moderator, UL power sharing for inter-band can simplify or ease RAN1 discussion. One thing needs to be clear is whether it is mandorty or UE capablity. In NR, power sharing is reported by UE capability.  |
| Nokia, Nokia Shanghai Bell | Power sharing can be considered for inter-band operation but solutions for intra-band case should also be studied. RAN1 LS R1-1913686 says that network cannot always ensure that UL transmissions to source and target cell do not overlap.  |
| ZTE | OK with the proposal |

As proposed in [1][3], RRC parameters corresponding to PowerCoordinationInfo-r12 would be introduced. The network could then control the used power sharing.

1. RRC parameters corresponding to PowerCoordinationInfo-r12 are introduced.

Please express your views about the above proposal.

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| Company | Comment |
| Ericsson | OK with the proposal. |
| Qualcomm | OK with the proposal |
| Huawei/HiSilicon | The intention is unclear. Is it to agree on the parameter name or agree on the principle that some parameters will be needed but up to RAN2 for the specific parameter name.  |
| Nokia, Nokia Shanghai Bell | Ok, new RRC parameters are needed if power sharing is introduced |
| ZTET | OK with the proposal |

It is the understanding of the moderator that if power sharing behavior is defined

One of the most difficult issues during the specification of NR DAPS was the issue of UL cancellation: in case the NW schedules UL in source and target at the same time, and power sharing should not be applied, what would be the UE behavior? In NR, this configuration is allowed, and the UE is specified. It is however associated with minimum offset, which were difficult to agree on. Thus, for LTE, the moderator proposes:

1. UL cancellation is not supported for LTE DAPS

Please express your views about the above proposal.

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| Company | Comment |
| Ericsson | OK with the proposal. |
| Qualcomm | Actually, RAN1 already agreed to support UL cancellation. See LS R1-1913686:*In both TDM realization methods, transmission of certain signals/channel (e.g. PRACH) at the source cell during DAPS based LTE handover may collide with target cell transmission. For handling of these cases, RAN1 agrees that UEs prioritize transmission of the signals/channels to the target cell.* |
| Huawei/HiSilicon | UL cancelation mechanisms in NR DAPS was introduced after agreeing on prioritizing target when overlapped. The timeline defined for the cancelation took long discussion time and with MSG3 still pending. I hasitate to see the similar thing/discuss happen in LTE DAPS again. We also need to note that UL cancelation is componenet feature for intra-freqency DAPS but up to UE capability for other cases. I’d like to understand better which cases we are talking about for this proprosal.  |
| Nokia, Nokia Shanghai Bell | We have the same understanding as Qualcomm. We think that RAN1 should discuss, how prioritization of target cell transmission can be captured in the specifications. |
| ZTE | OK with the proposal. Even if UL cancellation is supported, it may be sufficient to say a UE prioritizes transmission of the signals/channels to the target cell in case of collision. We don’t think it needs to define a specific timeline for cancellation which is expected to be very time-consuming to conclude. |

Here we note that since UL cancellation is not supported, there is really no point for the NW to signal that power sharing should not be performed, i.e., not to provide PowerCoordinationInfo: the NW must ensure that the UL transmissions are not overlapping in this case.

Finally, there was a discussion about UE capabilities. As the power sharing for DC relies on UE capabilities, there was a proposal to define corresponding capabilities also for UL power sharing for LTE DAPS. Thus, the moderator proposes

1. UE capabilities corresponding to dc-Support-r12 are introduced.

Please express your views about the above proposal.

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| Company | Comment |
| Ericsson | OK with the proposal. |
| Qualcomm | OK with the proposal |
| Huawei/HiSilicon | We are ok in principle to discuss the capablity but prefer to discuss it in a whole picture after all the issues are fixed. I guess proposal 4 may not be a single capability needs to be defined before we get consensus for other issues, e.g., proposal 3. Also, shall we use the same parameter name as DC or a new name? In NR DAPS, we basically reused NR-DC power control mechanims but new parameters are defined instead of reusing parameters defined from NR-DC.  |
| Nokia, Nokia Shanghai Bell | OK. If power sharing is introduced, related capability signaling is needed. |
| ZTE | OK with the proposal |

# References

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2. [R1-2006336](file:///C%3A%5C%5CUsers%5C%5Cwanshic%5C%5COneDrive%20-%20Qualcomm%5C%5CDocuments%5C%5CStandards%5C%5C3GPP%20Standards%5C%5CMeeting%20Documents%5C%5CTSGR1_102%5C%5CDocs%5C%5CR1-2006336.zip), [DRAFT] Reply LS on power sharing for LTE mobility enhancements, ZTE, RAN1#102-e, August 2020
3. [R1-2006337](file:///C%3A%5C%5CUsers%5C%5Cwanshic%5C%5COneDrive%20-%20Qualcomm%5C%5CDocuments%5C%5CStandards%5C%5C3GPP%20Standards%5C%5CMeeting%20Documents%5C%5CTSGR1_102%5C%5CDocs%5C%5CR1-2006337.zip), Discussion on uplink power sharing for LTE mobility enhancements, ZTE, RAN1#102-e, August 2020
4. [R1-2006925](file:///C%3A%5C%5CUsers%5C%5Cwanshic%5C%5COneDrive%20-%20Qualcomm%5C%5CDocuments%5C%5CStandards%5C%5C3GPP%20Standards%5C%5CMeeting%20Documents%5C%5CTSGR1_102%5C%5CDocs%5C%5CR1-2006925.zip), Power sharing for LTE mobility enhancements Huawei, HiSilicon, RAN1#102-e, August 2020
5. [R1-2006926](file:///C%3A%5C%5CUsers%5C%5Cwanshic%5C%5COneDrive%20-%20Qualcomm%5C%5CDocuments%5C%5CStandards%5C%5C3GPP%20Standards%5C%5CMeeting%20Documents%5C%5CTSGR1_102%5C%5CDocs%5C%5CR1-2006926.zip), [DRAFT] LS reply to RAN2 on power sharing for LTE mobility enhancements, Huawei, HiSilicon, RAN1#102-e, August 2020