**3GPP TSG RAN WG1 Meeting #106bis-e R1-210xxxx**

**e-Meeting, October 11th-19th, 2021**

**Agenda Item: 5.1**

**Source: Moderator (Huawei)**

**Title: [Draft] Summary#1 of email discussion [106bis-e-NR-SCell-Dropping] on reply LS to R1-2108701**

**Document for: Discussion and Decision**

# Introduction

A RAN4 LS [1] asks RAN1 three questions on UL power control of SCells in NR-CA, as copied below.

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| ***Reference:******[1] R4-2103410, “LS on Scell dropping”, RAN4 #98-e******1. Overall Description:****RAN #92-e tasked RAN4 to further discuss on Scell dropping issue. Discussion on Scell dropping of CA is triggered by a measurement problem found in MoP(maximum output power) of FR2 intra-band UL CA and later commented the same unexpected SCell dropping issue is found problematic also in field operation (R4-2112826). Meanwhile, it is also confirmed by RAN4 that the problem also exists for FR1 CA. The background and suggestion on CA measurements are captured in [1] and sent to RAN5.* *In TS 38.213, the transmission priority rule for CA is specified based on physical channel, and also with: “In case of same priority order and for operation with carrier aggregation, the UE prioritizes power allocation for transmissions on the primary cell of the MCG or the SCG over transmissions on a secondary cell”. Thus, the UE is always required to drop the power on cell with lower priority when the configured power on cell with high priority occupies all power ability of the UE.* *In order to advance the above discussions, RAN4 would like to ask RAN1 following questions:****Question 1:*** *Whether UE drop Scell power according to the priority rule defined in 38.213 is considered as an issue from RAN1 perspective.****Question 2:*** *Whether UE drop Scell power according to the priority rule defined in 38.213 has been addressed from 16 or 17? If not, what expected solution(s) are?****Question 3:*** *If the problem above is solved in RAN4 specifications with solution by higher layer configuration, e.g. introduce additional UE-specific configuration of power limits on Pcmax,f,c for each CC to prevent SCell dropping (see e.g. R4-2112826 or R4-2114551 for details), is there any expected RAN1 spec impact or possible conflict with UE behaviour defined in RAN1 specifications?* |

As per chairman’s guidance, a reply LS is discussed and is expected to complete by October 18.

[106bis-e-NR-SCell-Dropping] Discuss incoming LS on SCell dropping issue of CA for a possible reply LS by October 18 – Frank (Huawei)

# Discussions

## Q1: Whether UE drop Scell power according to the priority rule defined in 38.213 is considered as an issue from RAN1 perspective.

Based on the contribution papers [2-7], companies have different views with respect to the question. To be specific, some companies concern about RAN1 specification impact and expect that the priority rule defined in 38.213 since Rel-15 should be unchanged. Therefore, to address such concern, whether the priority rule should be kept or not could be discussed.

### Question 1-1: Whether UE drop Scell power according to the priority rule defined in 38.213 is considered as an issue from RAN1 perspective. Whether the priority rule defined in TS 38.213 should be kept unchanged or not.

Companies’ views are very welcome.

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| *Company* | *View* |
| Nokia, NSB | RAN1 specifications define power scaling (not dropping) rules because there is not enough Tx power to satisfy all the signals and channels to be transmitted. Changing the priority rule doesn’t help the underlying problem of running out of Tx power. UE dropping a transmission instead of scaling Tx power according to the 38.213-defined priority rule is against the intent of the RAN1 specification and in that respect it is an issue from RAN1 perspective.**Proposed Answer to Q1**: RAN1 specifies power scaling priority rules when the UE doesn’t have sufficient power budget to meet the requested Tx power on all the uplink transmissions. UE dropping instead of scaling is in contradiction to this specified behaviour and is in RAN1 perspective problematic. RAN1 doesn’t see changes to the RAN1 specification a way to address such kind of issues. |
| ZTE | From our perspective, the priority rule defined in TS38.213 should be kept unchanged. RAN1 specification (TS38.213) defines prioritization rules among cells and among transmissions. However, RAN1 doesn’t specify any detailed mechanism (e.g., how to scale the power) for UE to prioritize or deprioritize transmission. It is up to UE’s implementation from RAN1 perspective as long as it satisfies RAN4 requirements. Thus, from RAN1 perspective, UE drop Scell power according to the priority rule defined in 38.213 is NOT considered as an issue. |
| NTT DOCOMO | The issue of SCell dropping actually exists in commercial test with power limited case. We think it would be good if the issue can be solved by RAN4 or RAN1. From RAN1 perspective, the current power scaling and priority rules should be basically ok. We may just need to have some way to avoid SCell dropping in power limited CA case without causing performance degradation in other normal cases. |
| vivo | We do not see any issue on UE drop SCell power according to the priority rule defined in TS 38.213 from the perspective of RAN1 and UE implementation, other than RAN5 CA measurements. In our point of view, this issue can be avoided by proper configuration for RAN5 testing. Therefore, the priority rule defined in TS 38.213 should be kept unchanged. |
| Ericsson | We do not see need to change priority rules in RAN1.**Proposed response for Q1[5]**: RAN1 specifications allow the PCell and SCell transmission power to be adjusted by using closed loop TPC commands (and other parameters such as P0, number of allocated RBs etc.) so that UE transmits on both PCell and SCell(s) for UL CA. For case when UE is power limited, RAN1 specifications define a priority order for power allocation between different cells/transmissions (e.g., in case of same type of transmissions, power allocation for transmissions on the primary cell are prioritized over transmissions on a secondary cell). Depending on various aspects (e.g., lack of accurate/timely PHR reports, TPC command adjustments) it is possible that gNB and UE have different understanding on whether UE is power limited, and in such cases SCell dropping due to power limitation can occur. |
| Qualcomm | It has not been an issue from RAN1 perspective. TS38.213 specifies a rule for a UE to allocate its transmission power based on the priority order in case the UE is in power-limited. If one or some of overlapping UL transmissions require more than the total available power the UE can allocate, the rest of overlapping UL transmission(s) may not get any power. This is what RAN1 designed for UL-CA in Rel-15.  |
| OPPO | It is not an issue for RAN1 perspective. The priority rule defined in TS 38.213 should be kept |
| Moderator | Majority view is no RAN1 spec change to the priority rule.**Proposed Answer to Q1:** Depending on various aspects (e.g., lack of accurate/timely PHR reports, TPC command adjustments) it is possible that gNB and UE have different understanding on whether UE is power limited, and in such cases SCell dropping due to power limitation can occur. But RAN1 doesn’t see changes to the priority rule defined in TS 38.213 as a way to address such issue. |

## Q2: Whether UE drop Scell power according to the priority rule defined in 38.213 has been addressed from 16 or 17? If not, what expected solution(s) are?

Please note that there are **some proposed solutions in [6], R4-2112826 and R4-2114551.**

E.g. in [6]

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| **Proposal 2:*** Introduce a higher-layer parameter for relative power offset to reflect the priority difference for concurrent UL transmissions in case of power-limited.
* For UL-CA power-limited handling, the UE allocates transmission powers to the concurrent transmissions taking into account the total available power and the relative power offset.

**Proposal 3:*** Adopt either of the following UL-CA power-limited handling:
	+ Option 1:
		- Find K that satisfies $K×\left\{P\_{req\\_U1}+P\_{tmp\\_U2}\right\}\leq P\_{CMAX}$
			* where $P\_{tmp\\_U2}=min\left\{P\_{req\\_U2}, δ×P\_{req\\_U1}\right\}$, and
			* $P\_{req\\_U1}$ and $P\_{req\\_U2}$ are the requested transmission powers for U1 and U2 before power-limited handling, respectively
		- Transmit power for U1 is given by $P\_{U1}=min\left\{P\_{req\\_U1}, K×P\_{req\\_U1}\right\}$
		- Transmit power for U2 is given by $P\_{U2}=min\left\{P\_{req\\_U2}, P\_{CMAX}-P\_{U1}\right\}$
	+ Option 2:
		- Find K that satisfies $K×\left\{P\_{req\\_U1}+P\_{tmp\\_U2}\right\}\leq P\_{CMAX}$
			* where $P\_{tmp\\_U2}=min\left\{P\_{req\\_U2}, δ×P\_{max⁡\\_U2}\right\}$, and
			* $P\_{req\\_U1}$ and $P\_{req\\_U2}$ are the requested transmission powers for U1 and U2 before power-limited handling, respectively, and $P\_{max⁡\\_U2}$ is the maximum available power for U2 when there is no concurrent transmission(s) (e.g., PCMAX,f,c)
		- Transmit power for U1 is given by $P\_{U1}=min\left\{P\_{req\\_U1}, K×P\_{req\\_U1}\right\}$
		- Transmit power for U2 is given by $P\_{U2}=min\left\{P\_{req\\_U2}, P\_{CMAX}-P\_{U1}\right\}$
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Companies’ views are very welcome.

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| *Company* | *View* |
| Nokia, NSB | **Proposed Answer to Q2**: RAN1 has not changed the power scaling priority rules in Rel-16 and is not working to modify them in Rel-17. |
| ZTE | It seems these proposals are discussing under RAN4, not sure whether RAN1 needs to anything here. |
| NTT DOCOMO | We share the same understanding with Nokia. |
| vivo | Since there is no issue identified on UE drop SCell power according to the priority rule defined in TS 38.213, no solution is expected in R16 and R17. If the intention is to prevent SCell dropping and the dropping behavior controlled by NW, we need to discuss the use cases, conditions firstly, then we can try to find a reasonable solution. |
| Ericsson | **Proposed response to Q2[5]:** There was no RAN1 discussion on this issue in Rel16. For Rel17, no spec changes are identified by RAN1 and RAN1 understands that RAN4 is discussing potential RAN4 specification updates. |
| Qualcomm | RAN1 has not done any major changes for UL-CA power prioritization in Rel-16 or in Rel-17 until today. The proposal in [6] R1-2110162 is the power-scaling procedure that addresses the RAN4/RAN5 concern while keeping the RAN1 design principle of power allocation prioritization. |
| OPPO | Since it is not an issue from RAN1 perspective, there is no RAN1 spec change so far |
| Moderator | Majority view is no RAN1 spec change.**Proposed Answer to Q2:** No, RAN1 is not working to modify the power scaling priority rule in Rel-17 either, and understands that RAN4 is discussing potential RAN4 specification updates. |

## Q3: If the problem above is solved in RAN4 specifications with solution by higher layer configuration, e.g. introduce additional UE-specific configuration of power limits on Pcmax,f,c for each CC to prevent SCell dropping (see e.g. R4-2112826 or R4-2114551 for details), is there any expected RAN1 spec impact or possible conflict with UE behaviour defined in RAN1 specifications?

Companies’ views are very welcome.

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| *Company* | *View* |
| Nokia, NSB | The uplink Tx power allocation specification split between RAN1 and RAN4 specifications are complicated so it is difficult to give a blanket answer without knowing exactly what the solution RAN4 would adopt is, but it should be possible to introduce such limits directly to the RAN4 specs without impacting the RAN1 specification.**Proposed Answer to Q3**: RAN1 believes that it is possible to mitigate the referred issue directly in RAN4 (and potentially RAN2) specifications without impacting RAN1 specifications, but a definite answer can only be provided when the detailed solution is agreed in RAN4 |
| ZTE | From our perspective, RAN1 specification defines how to calculate the desired power and priority rule. RAN4 specification defines the power limitation. It is possible that there is no RAN1 impact for these potential solutions, effectively it only changes the power limitation and the RAN1 spec can kept as it is. |
| NTT DOCOMO | Whether there is any RAN1 impact or not would depend on the solution. The solution in R4-2112826 would not require RAN1 spec impact (as described in R4-2112826 that “no change of RAN1 specifications (including priority mechanism)”), while the solution in R4-2114551 would have RAN1 spec impact as it proposes to introduce new parameter indicating priority between UL cells (i.e., the priority rule may be impacted). |
| vivo | When we discuss the potential solutions to prevent SCell dropping, UL coverage and throughput performances also should be considered, not only RAN1 spec impact. Both of the proposed two solutions have impact on UL performance on PCell, due to the power limitation on PCell. Using MAC-CE activated or deactivated the related configuration also has RAN1 spec impact. |
| Ericsson | **Proposed response[5]:** The proposal in R4-2112826 is not expected to have RAN1 spec impact. The proposal in R4-2114551 is expected to impact at least the RAN1 specification related to power prioritization rules for CA case.Since Pcmax |
| Qualcomm | As long as the RAN4 referred solution, “introduce additional UE-specific configuration of power limits on Pcmax,f,c for each CC to prevent SCell dropping”, is just about how the Pcmax,f,c is determined, there would be no RAN1 spec impact or UE behavior change.On the other hand, we are not so sure whether the solution resolves the issue with keeping the power allocation priority concept designed by RAN1. In our understanding, the primary intention of this solution is to have an additional backoff on Pcmax,f,c for PCell (=higher priority transmission), so that SCell (=lower priority transmission) can get at least a certain amount of power. We think this is a suboptimal solution due to the following reasons:* Reducing power of higher priority transmission (and then redirect the power to lower priority transmission) is an opposite approach of what RAN1 has designed for power control in UL-CA.
* The relative priorities among overlapped transmissions change dynamically over transmission occasions. However, the configuration is for each CC. If the network wants to ensure lower priority transmission not to be dropped, the backoff has to be configured on all the CCs where high priority transmission with high power can potentially takes place. This would result in semi-static power reduction on multiple (or all) CCs.
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| OPPO | The answer depends on the detailed solution(s) of RAN4. At least, the proposal “Define new parameter to indicate priority between configured UL cells for the UE” of R4-2114551 is conflicting with the current RAN1 specification. |
| Moderator | Thank you all for your feedbacks. Companies views are summarized as,* Any RAN4 solution for the power scaling issue should not have any RAN1 spec impact.
* Regarding whether a RAN4 solution is conflicting with UE behavior specified in RAN1, a definite answer can only be provided when the detailed solution is agreed in RAN4
* There is no RAN1 spec impact by introducing additional UE-specific configuration of power limits on Pcmax,f,c for each CC to prevent SCell dropping
* Using MAC-CE activated or deactivated the related configuration has RAN1 spec impact.
* “Define new parameter to indicate priority between configured UL cells for the UE” of R4-2114551 is conflicting with the current RAN1 specification.
* Both solutions proposed in R4-2112826 and R4-2114551 have impact on UL performance on PCell, due to the power limitation on PCell.

Since the RAN4 question focus on RAN1 specification impact, and the performance impact on PCell is quite straightforward given limited total UL power for all cells, RAN4 may have been aware of it. Therefore, suggest not to include the last bullet above to the answer in reply LS.**Proposed Answer to Q3:** In RAN1 understanding, any RAN4 solution for the concerned issue is expected to have no RAN1 specification impact. Regarding whether a RAN4 solution is conflicting with UE behavior specified in RAN1 or not, a definite answer can only be provided when the detailed solution is agreed in RAN4. Regarding the solution examples, there is no RAN1 specification impact by introducing additional UE-specific configuration of power limits on Pcmax,f,c for each CC to prevent SCell dropping, but using MAC-CE activated or deactivated the related configuration has RAN1 specification impact. The proposal “Define new parameter to indicate priority between configured UL cells for the UE” is conflicting with the current RAN1 specification. |

## Draft text for reply LS

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| **1. Overall Description:**RAN1 thanks RAN4 for the LS on SCell dropping issue of CA. Regarding the questions raised in the LS, RAN1 answers are as follows.**Question 1:** Whether UE drop Scell power according to the priority rule defined in 38.213 is considered as an issue from RAN1 perspective.**Answer**: Depending on various aspects (e.g., lack of accurate/timely PHR reports, TPC command adjustments) it is possible that gNB and UE have different understanding on whether UE is power limited, and in such cases SCell dropping due to power limitation can occur. But RAN1 doesn’t see changes to the priority rule defined in TS 38.213 as a way to address such issue.**Question 2:** Whether UE drop Scell power according to the priority rule defined in 38.213 has been addressed from 16 or 17? If not, what expected solution(s) are?**Answer**: No, RAN1 is not working to modify the power scaling priority rule in Rel-17 either, and understands that RAN4 is discussing potential RAN4 specification updates.**Question 3:** If the problem above is solved in RAN4 specifications with solution by higher layer configuration, e.g. introduce additional UE-specific configuration of power limits on Pcmax,f,c for each CC to prevent SCell dropping (see e.g. R4-2112826 or R4-2114551 for details), is there any expected RAN1 spec impact or possible conflict with UE behaviour defined in RAN1 specifications?**Answer**: In RAN1 understanding, any RAN4 solution for the concerned issue is expected to have no RAN1 specification impact. Regarding whether a RAN4 solution is conflicting with UE behaviour specified in RAN1 or not, a definite answer can only be provided when the detailed solution is agreed in RAN4. Regarding the solution examples, there is no RAN1 specification impact by introducing additional UE-specific configuration of power limits on Pcmax,f,c for each CC to prevent SCell dropping, but using MAC-CE activated or deactivated the related configuration has RAN1 specification impact. The proposal “Define new parameter to indicate priority between configured UL cells for the UE” is conflicting with the current RAN1 specification.**2. Actions:****To:** RAN4**ACTION:** RAN1 respectfully ask RAN4 to take the above answers into account in their further work. |

Companies’ comments are welcome. Please provide your suggested revision to answers into section 2.1 – 2.3. Here is only addressing potential revision that have not been covered by section 2.1- 2.3.

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## Other Issues

Issues or comments that do not fit in any of the previous sections of this document can be provided in this section.

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# Conclusions

TBD

# References

1. R1-2108701 LS on scell dropping issue of CA, RAN4, Huawei
2. R1-2108947 Draft reply LS on Scell dropping issue of CA vivo
3. R1-2109048 Discussion on "LS on scell dropping issue of CA" OPPO
4. R1-2109139 [Draft] Reply LS on Scell dropping issue of CA ZTE
5. R1-2110135 Draft Reply to RAN4 LS on SCell dropping issue of CA Ericsson
6. R1-2110162 Discussion on LS on SCell dropping issue of CA Qualcomm Incorporated
7. R1-2108776 Reply LS on Scell dropping issue of CA Huawei, HiSilicon

# Appendix: