**3GPP TSG-RAN WG1 Meeting #110bis-eR1-22XXXXX**

E-meeting, Oct. 10th – 20th, 2022

**Agenda item: 8.3**

**Source: Moderator (Nokia)**

**Title: Moderator summary #X on Maintenance of HARQ-ACK feedback enhancements for NR Rel-17 URLLC/IIoT**

**Document for: Discussion and Decision**

# Introduction

As per chairman’s guidance, the email discussion is planned according to the following schedule:

[110bis-e-R17-IIoT-URLLC-01] Email discussion to determine maintenance issues to be handled in RAN1#110bis-e by October 12 – Klaus (Nokia)

* Additional email discussions will be set up once the maintenance issues for RAN1#110bis-e are determined

**This document focuses on maintenance of HARQ-ACK enhancements**

# Issue#1: PUCCH repetition with semi-static PUCCH cell switching

* 1. Background & companies’ inputs

This issues was shortly discussed during the 38.213 editor CR post-meeting discussions of RAN1#109-e based on the following RAN1#109-e agreement:

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| **Agreement**For semi-static PUCCH cell switch and PUCCH repetitions: * Semi-static PUCCH cell switching is applicable only to PUCCH transmissions without repetitions.
	+ *Note: UE assumes there is no PUCCH scheduling on multiple slots mapped to PCell and PUCCH-sSCell. i.e., gNB need to schedule carefully so there is no such case where a PUCCH repetition from PCell would be need to be transmitted in a slot indicated by the pattern for PUCCH transmission on PUCCH-sSCell (as for slot #X+3 in the example figure below)*

* **Conclusion**: PUCCH repetitions are only applicable on Pcell, PScell, and PUCCH Scell.
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During RAN1#110, there had been further discussions with the following discussed way to proceed on this issue, see Sec. 2.3.9 of the final moderator summary in R1-2208102:

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| Therefore, the companies discussed / concluded the following handing / next steps: * We try to support PUCCH cell switching in a way, that for slots with a PUCCH repetition the PUCCH cell pattern is not applicable (i.e. the UE neglects / does not apply the PUCCH cell switching pattern indication for such slots)
	+ This operation is sketched in the following figure:
	+ Moderator Note / explanation: The red crossing out means the pattern is not applicable / neglected and the UE transmits the PUCCH on PCell – so the pattern would again only be applied from Slot X+3 (after the rep bundle)
		- For the first repetition, the gNB will still need to guarantee the PUCCH to be on PCell – therefore there is no ‘crossed out’ for slot #X, but starts only in the next slot
		- The PUCCH cell pattern to be applicable applies to all the slots until the UE has transmitted the last PUCCH repetition (so also including the time that there would be some potential PUCCH repetition deferral based on 9.2.6 of 38.213). So for the case above, the pattern would only be applicable again from slot X+3
		- The pattern not being applicable / neglected by the UE applies also for PUCCH transmissions without repetition when having an ongoing PUCCH repetition bundle and is applicable for scheduled PUCCH (through DCI) as well as for non-scheduled PUCCH.
			* This is to prevent that there would be PUCCHs on PCell (through the repetition) and any other PUCCH in overlapping slot on PUCCH-sSCell.
* Companies will check if there are any specific issues / showstoppers for this operation till RAN1#110b-e and will check how this would need to be implemented in the specifications (which may require specially also checking the details of the PUCCH repetition operation incl. deferral in Sec. 9.2.6 of 38.213)
* It is encouraged that if someone identifies some issues / showstoppers to inform other interested companies offline about the findings to be able to check these issues possibly already before RAN1#110b-e.
* At RAN1#110b-e:
	+ If no showstoppers / major issues are identified, we try to agree the related CRs (if needed, intention is to prevent any ambiguity) to have the intended operation as outline in the first bullet agreed.
	+ If showstoppers / major issues are identified, we may need to revert the earlier agreement to support the combination of semi-static PUCCH cell switching and PUCCH repetition operation.
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### Overall companies positions

The overall support has been provided:

* **Alt. 2A from RAN1#108-e: CATT** (in [**R1-2208938**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208938.zip), no draft CR / TP), **LG** (in [**R1-2209448**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209448.zip), no draft CR / TP)
	+ Arguments:
		- CATT: RAN1#110 intention (i) increases latency, (ii) increases complexity, (iii) may result in different understanding between gNB & UE, (iv) different SCS handling would need to be clarified and (v) SR handling is unclear
		- LG: RAN1#110 intention (i) introduces complicated timeline issues, (ii) increases UE & gNB complexity and (iii) ambiguity between gNB & UE
	+ Description of Alt. 2A (from RAN1#108-e):

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| * **For semi-static PUCCH cell switching, a PUCCH repetition transmission on a different target PUCCH cell from the PUCCH cell of the first PUCCH repetition is not supported**
	+ **A PUCCH slot mapped to different PUCCH cell is considered as invalid for PUCCH repetition and is not counted towards the total number of PUCCH repetitions, i.e., the repetition is postponed as in Rel-16.**
* **PUCCH repetitions are only applicable on PCell, PScell, and PUCCH SCell.**
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* **Intention of the RAN#110 discussions (see details above):** **HW / HiSi** (???, [**R1-2208465**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208465.zip), ‘if reverted’, proposals on clarification, no TP/draft CR), **ZTE** ([**R1-2209466**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209466.zip), ‘if proposals 1 to 3 are adopted', no TP/draft CR), **QC** (in [**R1-2209945**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209945.zip), one proposal for clarification, no TP / draft CR), **Ericsson** (draft CR in [**R1-2210142**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210142.zip)), **Nokia/NSB** (discussion with proposals in [**R1-2210146**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210146.zip), draft CR in [**R1-2210147**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210147.zip))
* **‘Original’ RAN1#109 intention:** **ZTE** ([**R1-2209466**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209466.zip), ‘if proposals 1 to 3 not are adopted', no TP/draft CR)
	+ Further details:
		- ZTE: only PUCCH repetition on PCell is allowed based on the agreement in RAN1#109

### Additional requirements / proposals / clarifications on the RAN1#110 intention

HW / HiSi in [**R1-2208465**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208465.zip) proposes the following:

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| ***Proposal: If the 109-e agreement is reverted with the 110 meeting solution, consider the following for the joint operation between PUCCH repetition and semi-static PUCCH cell pattern:**** ***UE expects that PUCCH with repetitions are always indicated to transmit on PCell***
* ***UE does not expect to be indicated by the semi-static PUCCH cell pattern as sSCell on the slot of the 1st PUCCH repetition***
* ***For PUCCH repetition(s) other than the 1st repetition, UE always transmits the PUCCH repetition on PCell regardless of the indication of the semi-static PUCCH cell pattern***
* ***For another scheduled/configured PUCCH without repetition, consider one of the following:***
	+ ***Opt1: if it occurs within the same PCell slot with the PUCCH repetition(s) other than the 1st repetition, UE transmits the scheduled/configured PUCCH also on the PCell regardless of the indication of the semi-static PUCCH cell pattern, and the multiplexing in clause 9.2.5 and 9.2.6 in 38.213 happens after determining the PCell***
	+ ***Opt2: UE does not expect the scheduled/configured PUCCH without repetition occurs within the same PCell slot with the PUCCH repetition(s) other than the 1st repetition if the PCell slot is indicated as sSCell by the semi-static PUCCH cell pattern.***
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ZTE in [**R1-2209466**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209466.zip) proposes the following:

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| ***Proposal 1:*** *RAN1 considers the Alt2 to ignore PUCCH cell switching patterns when PUCCH repetition is triggered.** *Alt2: PUCCH cell switching pattern are ignored in the slots determined for PUCCH repetition based on TS 38.213 section 9.2.6.*

***Proposal 2:*** *For ignoring PUCCH cell switching pattern,** *The first PUCCH repetition should be deferred if the first PUCCH repetition collides with DL symbols in the initial slot.* *The deferred first PUCCH repetition should still be guaranteed by gNB or UE to be on PCell based on PUCCH cell switching pattern.*
* *UE shall not ignore the PUCCH cell switching pattern in the initial slot if the first PUCCH repetition would be deferred from the initial slot.*

***Proposal 3:*** *For SR PUCCH repetition and PUCCH cell switching,** *If it is supported that for slots with a PUCCH repetition the PUCCH cell pattern is not applicable, the UE is expected to cancel the PUCCH transmission in a SCell slot before the first symbol of the SR PUCCH repetition in a PCell slot when the SCell slot overlaps with the PCell slot.*
* *The first repetition of SR PUCCH should not be transmitted by UE in a PCell slot if the PCell slot is not for PUCCH based on PUCCH cell switching pattern.*

***Proposal 4:*** *If the above proposal1~proposal3 are not supported in the this meeting, it is proposed to support the original proposal with potential limitation that only PUCCH repetition on PCell is allowed based on agreement in RAN1#109 meeting.* |

QC in [**R1-2209945**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209945.zip) proposed the following:

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| Proposal 1: Starting from a slot where a UE transmits the first repetition of a PUCCH until a slot where the UE transmits the last repetition of the PUCCH, the UE ignores the semi-static PUCCH cell switch pattern and transmits PUCCH (including PUCCH with repetitions and PUCCH without repetition) on Pcell.  |

Nokia / NSB in [**R1-2210146**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210146.zip) proposes the following:

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| * *Observation 1: To prevent a ‘first’ PUCCH repetition on PUCCH-sSCell, the simplest way would be to defined that the UE does not expect to be configured with any PUCCH resource with* $N\_{PUCCH}^{repeat}>1$ *on PUCCH-sSCell.*
* *Observation 2: Having the UE to neglect / not apply the PUCCH cell pattern for UL slots of the reference SCS configuration with a PUCCH transmission with* $N\_{PUCCH}^{repeat}>1$ *as determined in Sec. 9.2.6 of TS 38.213 (compared to decision per PCell PUCCH slot) would simplify the specification effort and guarantee the PUCCH cell switching times aligned with the time-domain pattern granularity.*
* *Observation 3: To prevent uncertainty on the PUCCH cell switching operation a change to the current specification text is required so that the UE in addition to not transmit PUCCH on the cell not being indicated to also not process PUCCH on the cell not being indicated in the time-domain pattern.*
* *Observation 4: The decision to neglect / not apply the PUCCH cell pattern is to be based on the (pending) PUCCH repetitions of both priorities jointly, to guarantee the pattern is equally applied for either PHY priority.*
* Proposal: For semi-static PUCCH cell switching with PUCCH repetition:
	+ The UE does not expect to be configured with any PUCCH resource with $N\_{PUCCH}^{repeat}>1$ on the PUCCH-sSCell.
	+ *Note: This guarantees that semi-static PUCCH cell switching is not applicable for a first PUCCH repetition of a PUCCH repetition bundle to limit the UE complexity*
	+ The UE neglects / does not apply the time-domain pattern for UL slots of the reference SCS configurations with PUCCH transmission of either PHY priority with repetitions, starting from a slot where the UE would transmit a first repetition of the PUCCH until a slot where the UE would transmit a last repetition of the PUCCH as described in Clause 9.2.6.
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### TPs / Draft CRs for the RAN1#110 intention

Ericsson providing the following draft CR in [**R1-2210142**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210142.zip):

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| 9.A PUCCH cell switchingThis clause is applicable when a UE is provided a PUCCH-sSCell by *pucch-sSCell* and the PUCCH-sSCell is activated and does not have a dormant UL/DL active BWP. A UE can be provided a periodic cell switching pattern for PUCCH transmissions by *pucch-sSCellPattern.* Each bit of the pattern corresponds to a slot for a reference SCS configuration provided by *tdd-UL-DL-ConfigurationCommon* for the PCell with a value of '0' or a value of '1' indicating, respectively, the PCell or the PUCCH-sSCell as the cell for PUCCH transmissions during the slot of the reference SCS configuration. For slots of the reference SCS configuration with PUCCH transmissions of any priority, starting from a slot where the UE would transmit a first repetition of a PUCCH until a slot where the UE would transmit a last repetition of the PUCCH as described in Clause 9.2.6, the UE does not apply the provided pattern and transmits the PUCCHon the PCell. The UE does not transmit a PUCCH in a slot on a cell if the pattern indicates a different cell for PUCCH transmission during the slot. A slot on the active UL BWP of the PUCCH-sSCell does not overlap with more than one slot on the active UL BWP of the PCell. If a slot for the active UL BWP of the PCell overlaps with more than one slot on the active BWP of the PUCCH-sSCell and the UE would transmit a PUCCH on the PUCCH-sSCell, the UE considers the first of the overlapping slots for the PUCCH transmission on the PUCCH-sSCell.If a UE is provided *pucch-sSCellDyn* or *pucch-sSCellDynDCI-1-2*, a corresponding DCI format associated with generation of HARQ-ACK information by the UE can include a PUCCH cell indicator field [5, TS 38.212] with a value of '0' or a value of '1' indicating, respectively, whether a PUCCH transmission with the HARQ-ACK information by the UE is on the PCell or on the PUCCH-sSCell. When the UE transmits a PUCCH with HARQ-ACK information that is associated only with SPS PDSCH receptions, the UE transmits the PUCCH on the PCell. The UE does not expect the PUCCH cell indicator field to indicate the PUCCH-sSCell for a PUCCH transmission in a slot that overlaps with a slot on the PCell where the UE would transmit another PUCCH of same or different priority index.**< Unchanged parts are omitted >** |

Nokia / NSB providing the following draft CR in [**R1-2210147**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210147.zip):

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| 9.A PUCCH cell switchingThis clause is applicable when a UE is provided a PUCCH-sSCell by *pucch-sSCell* and the PUCCH-sSCell is activated and does not have a dormant UL/DL active BWP. A UE can be provided a periodic cell switching pattern for PUCCH transmissions by *pucch-sSCellPattern.* Each bit of the pattern corresponds to a slot for a reference SCS configuration provided by *tdd-UL-DL-ConfigurationCommon* for the PCell with a value of '0' or a value of '1' indicating, respectively, the PCell or the PUCCH-sSCell as the cell for PUCCH transmissions during the slot of the reference SCS configuration. For slots of the reference SCS configuration with PUCCH transmissions of any PHY priority, starting from a slot where the UE would transmit a first repetition of a PUCCH of a PHY priority until a slot where the UE would transmit the last repetition of the PUCCH as described in Clause 9.2.6, the UE does not apply the provided pattern but determines the PCell as the cell for PUCCH transmission. The UE ~~does not~~neither processes nor transmits a PUCCH in a slot on a cell if the pattern indicates a different cell for PUCCH transmission during the slot. A slot on the active UL BWP of the PUCCH-sSCell does not overlap with more than one slot on the active UL BWP of the PCell. If a slot for the active UL BWP of the PCell overlaps with more than one slot on the active BWP of the PUCCH-sSCell and the UE would transmit a PUCCH on the PUCCH-sSCell, the UE considers the first of the overlapping slots for the PUCCH transmission on the PUCCH-sSCell. The UE does not expect to be configured with any PUCCH resource with $N\_{PUCCH}^{repeat}>1$ on the PUCCH-sSCell.If a UE is provided *pucch-sSCellDyn* or *pucch-sSCellDynDCI-1-2*, a corresponding DCI format associated with generation of HARQ-ACK information by the UE can include a PUCCH cell indicator field [5, TS 38.212] with a value of '0' or a value of '1' indicating, respectively, whether a PUCCH transmission with the HARQ-ACK information by the UE is on the PCell or on the PUCCH-sSCell. When the UE transmits a PUCCH with HARQ-ACK information that is associated only with SPS PDSCH receptions, the UE transmits the PUCCH on the PCell. The UE does not expect the PUCCH cell indicator field to indicate the PUCCH-sSCell for a PUCCH transmission in a slot that overlaps with a slot on the PCell where the UE would transmit another PUCCH of same or different priority index.**< Unchanged parts are omitted >** |

* 1. Initial (pre-meeting) moderator assessment & suggested handling during RAN1#110bis-e

**The overall issue is still pending and valid.**

But looking at the overall companies’s positions in Sec. 1.1.1, there now seem to be again three different ways to support the feature proposed. The moderator had the understanding based on the RAN1#110 discussions, that the further discussions should only focus on the RAN1#110 discussed way:

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| Therefore, the companies discussed / concluded the following handing / next steps: 1. We try to support PUCCH cell switching in a way, that for slots with a PUCCH repetition the PUCCH cell pattern is not applicable (i.e. the UE neglects / does not apply the PUCCH cell switching pattern indication for such slots)

….1. At RAN1#110b-e:
	* If no showstoppers / major issues are identified, we try to agree the related CRs (if needed, intention is to prevent any ambiguity) to have the intended operation as outline in the first bullet agreed.
	* If showstoppers / major issues are identified, we may need to revert the earlier agreement to support the combination of semi-static PUCCH cell switching and PUCCH repetition operation.
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Instead, CATT & LG propose to support the operation of Alt. 2A of RAN1#108-e. The moderator would like to note here the following:

* Samsung objected in the 4th round in **RAN1#108-e** (see. Sec. 6.8 of [R1-2202774](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2202774.zip)) here:

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| *Company* | *Comments*  |
| Samsung | “Enough” for this proposal was at least one meeting ago. A proposal to enable the system to be worse than doing nothing (Rel-16), and to discard THE main use case for introducing the PUCCH cell switching feature, is bad enough on its own. However, the moderator apparently strongly believes such proposal needs special treatment compared to other non-agreed proposals with ‘large’ support, and should be repeatedly made, round-after-round and meeting-after-meeting, given the plentiful time available, the ease of e-meetings, and the absence of other issues. Will now be a last time or will it come back again in Round 5 or in RAN1#109-e/…? |

* The method had been further discussed **in RAN1#109-e** (see moderator summary in [R1-2205504](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2205504.zip)):
	+ - Sustained objection by Samsung in GTW session. Based on this status – the ‘Alt. 3’ had been develoved during RAN1#109-e (starting from the 3rd round of email discussions – see [R1-2205504](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2205504.zip)), which lead to the agreement taken at RAN1#109-e on the support of what was noted as ‘Alt. 3’ there in the discussions.

***Moderator comment on re-discussing Alt. 2A:***

* *Alt. 2A had not been discussion for the last about 1 ½ RAN1 meetings based on the (sustained) objection from Samsung during RAN1#108-e and RAN1#109-e – but instead alternative solutions were discussed in RAN1#109-e (i.e. ‘Alt.3’) as well as RAN1#110-e (see background in Sec. 1.1.)*
* ***Trying to re-discuss now Alt. 2A from moderator perspective again seems to be not really helping looking at the repeated (sustained) objections from Samsung. Moreover, the RAN1#110 tendency seemed to be to focus only on the RAN1#110 discussed method. Therefore, moderator would suggest to not re-discuss Alt. 2A and focus the discussions the RAN1#110 described operation.***

ZTE proposed to conditionally support the ‘Alt. 3’ (RAN1#109-e ‘intention) that had majority support in RAN1#109-e (looking at input there), but there had been Samsung objection there – which again led to the ‘Way forward’ on how to proceed in RAN1#110 (as noted above). **Also here, the moderator thinks it not to help here to rediscussing the ‘Alt. 3’ and would suggest to follow the discussed further handling in RAN1#110, i.e. to focus /continue the discussions on the RAN1#110-e ‘way forward’.**

**Moderator suggested handling:**

* **The issue to be treated overall RAN1#110bis-e, but**
* **the focus is limited to the RAN1#110-e discussed operation, i.e.:**
	+ ***… for slots with a PUCCH repetition the PUCCH cell pattern is not applicable (i.e. the UE neglects / does not apply the PUCCH cell switching pattern indication for such slots)***
	1. Issue to be handled during RAN1#110bis-e?

**Question: Do you support discussing Issue#1 (overall) during RAN1#110bis-e?**

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| Yes - support:  | CATT OPPO, LG, Intel, Nokia/NSB, Samsung , New H3C, vivo, Spreadtrum, ZTE, DOCOMO, Huawei, HiSilicon  |
| No - not support:  |  |

**Comments on the moderator comments / suggested handling or any other comments on the draft CR:**

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| *Company* | *Comments*  |
| CATT | We support discussing the issue in RAN1#110bis-e but we do not agree to only focus on the RAN1#110-e discussed operation.Yes, Samsung objected to Alt. 2A in RAN1#108-e with the argument that it may increase the latency of PUCCH repetition compared with switching within the PUCCH repetition bundle, which is against the purpose of introducing PUCCH cell switching. But we do not understand how the RAN1#110-e discussed operation resolves the concern. At least, we would like to hear Samsung and other companies’ views. Otherwise, the RAN1#110-e discussed operation is not acceptable to us considering the various issues as discussed in our contribution. |
| LG | We support to discuss the issue itself.  |
| vivo | We have sympathy on CATT’s comments. |
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**Proposal: The semi-static PUCCH switching & PUCCH repetition repetitions discussions are limited to the RAN1#110-e discussed operation, i.e.: *… for slots with a PUCCH repetition the PUCCH cell pattern is not applicable (i.e. the UE neglects / does not apply the PUCCH cell switching pattern indication for such slots)***

* **The earlier discussed Alt. 2A from RAN1#108-e and RAN1#109-e is out of scope of RAN1#110bis-e discussions.**
* **The earlier discussed Alt. 3 from RAN1#109-e is out of scope of RAN1#110bis-e discussions.**

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| Support:  | Nokia/NSB, Samsung |
| Object:  | CATT, LG, ZTE |

**Comments on the moderator comments / suggested handling or any other comments on the draft CR:**

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| *Company* | *Comments*  |
| CATT | See our comment above. |
| LG | Based on Samsung’s comment in RAN1#108-e, the reason to object Alt. 2A seems that Alt. 2A could make the system worse than Rel-16. However, the contributions from CATT and LG have pointed out that the RAN1#110-e discussed operation is worse than Alt. 2A. At least we think it is not fair to consider those options as out of scopes. |
| Intel  | Considering the issues raised by CATT and LG in tdocs, it seems the option discussed in RAN1 #110-e may require some addtional efforts or with degraded performance. Therefore, we’re also open to include Alt 2A in the scope.  |
| Nokia/NSB | Without the restriction and the fact that we have only 6 meetings days / 3 rounds available, we think the restriction will be needed – as otherwise, there will be no PUCCH repetition operation in Rel-17 (as this should not continue anymore in Nov / Toulouse).  |
| Samsung | We support a simple completion on this topic as its overall importance couldn’t be more marginal and a highly disproportionate time has already been allocated to it. We would prefer to leave the UE behavior undefined over defining any optimization with additional spec impact and possibility of additional conditions/UE behaviors.  |
| vivo | We are also open to include Alt 2A.  |
| ZTE | As CATT and LG pointed, there are some major issues of the proposal in RAN1#110 meeting, so it is better to reconsider the earlier proposals. |
| DOCOMO | Also open to include Alt 2A. |
| Huawei, HiSilicon | We support limiting the discussion to RAN1#110-e discussed operation, but also fine to include Alt 2A for further discussion considering indeed some additional issues identified to be further addressed for the RAN1#110-e.  |
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* 1. 1st round of email discussion

Strong majority of companies suggesting to discuss this issue, but there is no majority to restrict the discussions to the RAN1#110 intended behavior, but would like to keep Alt. 2A still on the table. Based on this the moderator suggests discussing on parallel the following:

* Alt. 2A vs. RAN1#110 behavior vs. RAN1#109 behavior (i.e. Alt. 3 earlier)
* Further details on the RAN1#110 behavior
* TPs if RAN1#110 behavior is to be adopted
* TPs if Alt. 2A is to be adopted

**General support and which ‘Alternative’**

It has been the moderator understanding, that the further discussions are to be restricted to the RAN1#110 discussed option (if this is to be supported at all). But CATT & LG propose going back to Alt. 2A from RAN1#108-e – and ZTE conditionally support the RAN1#110 intention only and otherwise suggest to go back to the RAN1#109-e interpretation.

But as companies prefer, let’s check the following:

**Question 1.1: PUCCH repetition for semi-static PUCCH switching is supported using:**

* **Option 1: According to Alt. 2A of RAN1#108-e**, i.e.
	+ *For semi-static PUCCH cell switching, a PUCCH repetition transmission on a different target PUCCH cell from the PUCCH cell of the first PUCCH repetition is not supported*
		- *A PUCCH slot mapped to different PUCCH cell is considered as invalid for PUCCH repetition and is not counted towards the total number of PUCCH repetitions, i.e., the repetition is postponed as in Rel-16.*
		- *PUCCH repetitions are only applicable on PCell, PScell, and PUCCH SCell.*
* **Option 2: According to the RAN1#110 discussed intention** (see the background in Sec. 1.1 & further potentially needed clarifications below in “*Details on the RAN1#110 intended operation”*)
* **Option 3: According to the RAN1#109-e intention, i.e.**
	+ *The UE does not expect to be indicated with the PUCCH-sSCell as the cell for PUCCH transmissions during a slot of the reference SCS configuration that would overlap with a slot on the active UL BWP of the PCell where the UE would transmit a PUCCH repetition.*

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| **Option 1:Alt. 2A of RAN1#108-e** | Support:  | Nokia/NSB, Intel (1st preference), vivo, CATT, Huawei/HiSilicon, QC, New H3C, OPPO, LG, ZTE |
| Object:  |  |
| **Option 2:** **The RAN1#110 intention** | Support:  | Nokia/NSB, Intel (2nd preference), vivo, Huawei/HiSilicon, QC, OPPO, ZTE, Samsung |
| Object:  |  |
| **Option 3: the RAN1#109 intention** | Support:  | Vivo, QC, ZTE |
| Object:  |  |

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| *Company* | *Comments*  |
| Nokia/NSB | Clearly Alt. 2A would be easier to specify than the RAN1#110 discussed option – as this is clearer and less needed further clarifications will be required. But we are (of course) open to the RAN1#110 discussed option as well. But still more discussions will be needed here to finally get there as we can see below.  |
| Intel  | Our 1st preference is option 1, with similar understanding with NOKIA. We’re open for option 2, if we can resolve open issues with reasonable performance.  |
| CATT | We agree with Nokia that Alt.2A is easier to specify than the RAN1#110 discussed option. In addition, the RAN1#110 intention does not resolve the earlier concern from objecting company of Alt. 2A according to our understanding.We could be open to Option 2 if companies can provide convicing technical reasons why Option 2 can address the previous concerns. |
| Huawei, HiSilicon | We also think Alt.2A is simpler and clearer. However, we also understand the situation on why RAN1#110 operation is here, so we are open for it also, as long as all those issues as shown in the following can be addressed.  |
| QC | We don’t have a strong view which option to take. We think the most important is finalizing Rel-17 spec on URLLC to allow some sort of joint operation of PUCCH repetition with semi-static cell switch. Otherwise, the outcome will be not allowing this joint operation, which effectively will disable the semi-static cell switch feature, as repetition is a more fundamental feature to have.  |
| New H3C | We agree with Nokia’s view on Alt.2A is simpler and clearer.  |
| LG | We think Alt. 2A is clear option and has less issues. We are open to Option 3 as well for gNB to avoid the joint operation between PUCCH carrier switching.  |
| ZTE | In our contribution, we just raise some issues based on the background of RAN1#110 meeting. We can accept any of alternatives which has the majority support. |
| Samsung | Alt.2A can be worse than the “RAN1#110 mode” for the latency of a PUCCH transmission with repetitions (can never be better). The “RAN1#109 intention”, without commenting on the interpretation of the “intention” itself, is not possible for any current or even conceivable deployment that can include PUCCH cell switching. |

We further discussed during RAN1#110-e, that we would not prolong the discussions beyond this RAN1 meeting. Just to have some backing on this one, the following is proposed here:

**Proposal 1.1: If the PUCCH repetition with semi-static PUCCH operation cannot be clarified by the end of RAN1#110bis-e (at least having the operation clarified or even the CR not agreed), the support for the feature combination is to be removed from Rel-17.**

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| Support:  | Nokia/NSB, Intel, vivo, CATT, Huawei/HiSilicon, New H3C, OPPO ,LG, ZTE, Samsung |
| Object:  |  |

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| *Company* | *Comments*  |
| Nokia/NSB | We should close this at this meeting, or remve the support of the feature combination.  |
| CATT | Although we want to support the joint operation, prolonged discussions may not help if we cannot converge in this meeting so we are fine with the proposal. |
| Huawei, HiSilicon | Agree with the moderator. By the way “RAN1#110-e” in the proposal should be “RAN1#110b-e”. |
| QC | We should avoid this outcome, as a group. As commented above, removing this joint feature is effectively removing the semi-static cell switch feature, because repetition is a more fundamental feature and normally enabled by NW.  |
| Samsung | In our opinion, it is rather clear that there is no benefit from supporting this feature – it is a most marginal one. Applicability is extremely limited (for UEs that can go in and out of coverage dynamically and the NW can also dynamically figure that out). Latency is not addressed for the case that it needs to be addressed – assuming the scenario for the feature to be applicable, what good is it for a NW or for a UE to use cell switching for a PUCCH transmission without repetitions but not use cell switching for a PUCCH transmission with repetitions? No NW will assume that it can operate with reduced latency for such a UE and no NW will configure that feature for a UE that may need to transmit PUCCH with repetitions. Nevertheless, the specifications will be burdened for no reason and, despite the optionality, a UE may implement the feature. The possibility for additional specification impact, as discussed in subsequent questions, for introducing support of such marginal feature during maintenance is difficult to justify.  |

**Details on the RAN1#110 intended operation**

In Sec. 1.1.2, there is input by several companies on some potentially needed clarifications.

**Handling the 1st repetition, if the 1st repetition is deferred due overlapping DL symbols / SSB**

Let’s consider the following example here, there is a PUCCH scheduled on PCell in the ‘initial’ slot (slot#N) , which is deferred to a later slot, so the PUCCH repetition bundle is starting in slot#N+1, the question is what is to be done in the slot of the first repetition, i.e. slot#N+1, is the Alt. 1 – is the pattern to be neglected here as well – or is Alt. 2, gNB to guarantee that the first ‘actual repetition’ that the PCell is indicated in the pattern.



**ZTE** discussed the following:

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| From our point of view, the first PUCCH repetition should be allowed to defer, which conforms to the section 9.2.6 of TS38.213. Also for the PUCCH transmission for UCIs scheduled or configured by gNB, e.g., HARQ-ACK or CSI, the deferred first PUCCH repetition should still be guaranteed by gNB to be transmitted in the PUCCH slot on PCell which is determined by PUCCH cell switching pattern.If PUCCH repetitions for SR occur in PCell, as SR is initiated by UE spontaneously, UE should guarantee the first SR PUCCH repetition on the PUCCH slot on PCell determined by PUCCH cell switching pattern. If the first SR PUCCH repetition is deferred, UE should guarantee the deferred first SR PUCCH repetition still on the PUCCH slot on PCell determined by PUCCH cell switching pattern.If the first PUCCH repetition is deferred in the above case, whether the UE ignores the PUCCH cell switching pattern in the initial slot of first PUCCH repetition? According to the principle of Alt2 in Section 2.1, the UE only ignores the PUCCH cell switching pattern in the slots determined for the PUCCH repetition. According to the principle of Alt1 in Section 2.1, the UE ignores the PUCCH cell switching pattern in the slots starting from the first PUCCH repetition slot until after the last PUCCH repetition is transmitted. So no matter which alternative is selected, the initial slot of deferred first PUCCH repetition is not determined for the PUCCH repetition and the ignoring of PUCCH cell switching pattern should not be applied. ***Proposal 2:*** *For ignoring PUCCH cell switching pattern,** *The first PUCCH repetition should be deferred if the first PUCCH repetition collides with DL symbols in the initial slot.* *The deferred first PUCCH repetition should still be guaranteed by gNB or UE to be on PCell based on PUCCH cell switching pattern.*
* *UE shall not ignore the PUCCH cell switching pattern in the initial slot if the first PUCCH repetition would be deferred from the initial slot.*

….In addition, UE should guarantee the first repetition of SR PUCCH to be on PCell. That is, the UE should ensure that the first repetition of SR PUCCH is transmitted in a PUCCH slot in PCell based on PUCCH cell switching pattern. In other words, if a PCell slot is not for PUCCH based on PUCCH cell switching pattern, the UE would not transmit the first repetition of SR PUCCH in the PCell slot. For example, in Figure 2, SR PUCCH repetition1 should not be triggered by UE in the 5th PCell slot because it is not for PUCCH based on PUCCH cell switching pattern. The HARQ-ACK PUCCH would be transmitted in the 5th SCell slot.Figure 2***Proposal 3:*** *For SR PUCCH repetition and PUCCH cell switching,** *If it is supported that for slots with a PUCCH repetition the PUCCH cell pattern is not applicable, the UE is expected to cancel the PUCCH transmission in a SCell slot before the first symbol of the SR PUCCH repetition in a PCell slot when the SCell slot overlaps with the PCell slot.*
* *The first repetition of SR PUCCH should not be transmitted by UE in a PCell slot if the PCell slot is not for PUCCH based on PUCCH cell switching pattern.*
 |

**Huawei** is suggesting a similar handling as part of their proposal – with the relevant parts marked as yellow here:

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| ***Proposal: If the 109-e agreement is reverted with the 110 meeting solution, consider the following for the joint operation between PUCCH repetition and semi-static PUCCH cell pattern:**** ***UE expects that PUCCH with repetitions are always indicated to transmit on PCell***
* ***UE does not expect to be indicated by the semi-static PUCCH cell pattern as sSCell on the slot of the 1st PUCCH repetition***
* ***For PUCCH repetition(s) other than the 1st repetition, UE always transmits the PUCCH repetition on PCell regardless of the indication of the semi-static PUCCH cell pattern***
* ***For another scheduled/configured PUCCH without repetition, consider one of the following:***
	+ ***Opt1: if it occurs within the same PCell slot with the PUCCH repetition(s) other than the 1st repetition, UE transmits the scheduled/configured PUCCH also on the PCell regardless of the indication of the semi-static PUCCH cell pattern, and the multiplexing in clause 9.2.5 and 9.2.6 in 38.213 happens after determining the PCell***
	+ ***Opt2: UE does not expect the scheduled/configured PUCCH without repetition occurs within the same PCell slot with the PUCCH repetition(s) other than the 1st repetition if the PCell slot is indicated as sSCell by the semi-static PUCCH cell pattern.***
 |

***Moderator comments:***

* For PUCCH with CSI and HARQ-ACK (scheduled or SPS), to the moderator understanding there should not be really an issue to not have the same handling as for the remaining repetitions, as the determination is done based on the initial slot already.
* But as ZTE pointed out, for PUCCH with SR the situation is of course a different one:
	+ If there is a PUCCH resource with SR configured in the initial slot / slot N, the gNB will not know that a positive SR is available at the UE and that the UE will therefore neglect the pattern in slot N+1 and transmit the 1st repetition PUCCH with SR on PCell. This would require the gNB to blind detect PUCCH on PCell and PUCCH-sSCell for the 1st repetition before knowing that a positive SR (with repetition) has been triggered by the gNB.
	+ For the remaining repetitions (2...4), this should be less of an issue for the gNB as the gNB can based on the identification of the 1st PUCCH repetition know that the UE is transmitting SR with PUCCH repetition.

So let’s check, if the UE is Alt. 1, to neglect the pattern for the 1st PUCCH repletion also (in case the 1st PUCCH repetition is to be deferred) or Alt. 2, the gNB to guarantee to indicate the PCell for the 1st PUCCH repetition.

**Question 1.3: If the 1st PUCCH repetition is deferred to a later slot from the initial slot due to collision with SSB / DL symbols based on Sec. 9.2.6 of TS 38.213,**

* **Alt. 1: the UE transmits the PUCCH repetition on PCell regardless of the indication of the semi-static PUCCH cell pattern for the slot of the 1st PUCCH repetition already**
* **Alt. 2: the UE does not expect to be indicated by the semi-static PUCCH cell pattern as sSCell on the slot of the 1st PUCCH repetition**
* **Alt. 3: the 1st repetition of SR PUCCH should not be transmitted by UE in a PCell slot if the PCell is not indicated as the cell for PUCCH transmission based on PUCCH cell switching pattern for that slot**

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| Alt. 1  | Vivo, [Samsung] |
| Alt. 2  | Nokia/NSB, Intel, vivo, CATT, Huawei, HiSilicon, QC, OPPO, LG, ZTE (Except the SR repetition in PCell) |
| Alt. 3  | ZTE |

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| *Company* | *Comments*  |
| Nokia/NSB | Alt. 2 for the case that the 1st SR repetition would be deferred |
| QC | For SR with repetitions, gNB can configure them only on Pcell and not configure SR resource with repetitions on Scell. This seems can simplify the specification and solve ZTE’s problem.  |
| ZTE | Alt.3 is only for the 1st repetition of SR PUCCH in PCell, as gNB cannot estimate the SR is positive or negative, then gNB can’t guaranteed that UE does not expect to be indicated by the semi-static PUCCH cell pattern as sSCell on the slot of the 1st PUCCH repetition. In this case, Alt.2 is not applicable. Only UE itself guarantees the SR to be transmitted in PCell. But we can live with Alt.2 if companies think this issue could be solved by restricting the configuration of SR. |
| Samsung | It is unclear whether anything needs to be agreed. The UE/gNB know that a PUCCH is to be Tx/Rx with repetitions on the PCell. For the case of positive SR, what is the problem if the UE generates the SR in a slot indicated for PUCCH transmission on the PUCCH-sSCell? The UE/gNB will anyway first Tx/Rx in the first available slot on the PCell.  |

**Handling in the ‘initial’ PUCCH slot (incl. the case of the 1st PUCCH repetition being not deferred)**

ZTE discussed the following:

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| ….So no matter which alternative is selected, the initial slot of deferred first PUCCH repetition is not determined for the PUCCH repetition and the ignoring of PUCCH cell switching pattern should not be applied. ***Proposal 2:*** *For ignoring PUCCH cell switching pattern,** *The first PUCCH repetition should be deferred if the first PUCCH repetition collides with DL symbols in the initial slot.* *The deferred first PUCCH repetition should still be guaranteed by gNB or UE to be on PCell based on PUCCH cell switching pattern.*
* *UE shall not ignore the PUCCH cell switching pattern in the initial slot if the first PUCCH repetition would be deferred from the initial slot.*
 |

**Huawei** is suggesting a similar handling, i.e. an indication PUCCH repetition should be only done in slots indicated on PCell:

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| ***Proposal: If the 109-e agreement is reverted with the 110 meeting solution, consider the following for the joint operation between PUCCH repetition and semi-static PUCCH cell pattern:**** ***UE expects that PUCCH with repetitions are always indicated to transmit on PCell***
* ***UE does not expect to be indicated by the semi-static PUCCH cell pattern as sSCell on the slot of the 1st PUCCH repetition***
* ***For PUCCH repetition(s) other than the 1st repetition, UE always transmits the PUCCH repetition on PCell regardless of the indication of the semi-static PUCCH cell pattern***
* ***For another scheduled/configured PUCCH without repetition, consider one of the following:***
	+ ***Opt1: if it occurs within the same PCell slot with the PUCCH repetition(s) other than the 1st repetition, UE transmits the scheduled/configured PUCCH also on the PCell regardless of the indication of the semi-static PUCCH cell pattern, and the multiplexing in clause 9.2.5 and 9.2.6 in 38.213 happens after determining the PCell***
	+ ***Opt2: UE does not expect the scheduled/configured PUCCH without repetition occurs within the same PCell slot with the PUCCH repetition(s) other than the 1st repetition if the PCell slot is indicated as sSCell by the semi-static PUCCH cell pattern.***
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**Nokia** discusses similar handling:

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| Looking at the following RAN1#110 discussions:

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| * Moderator Note / explanation: The red crossing out means the pattern is not applicable / neglected and the UE transmits the PUCCH on PCell – so the pattern would again only be applied from Slot X+3 (after the rep bundle)
	+ - For the first repetition, the gNB will still need to guarantee the PUCCH to be on PCell – therefore there is no ‘crossed out’ for slot #X, but starts only in the next slot
 |

the intention is clearly, that the UE would not be expected to find a PUCCH with $N\_{PUCCH}^{repeat}>1$on PUCCH-sSCell – and then based on the pattern not being applicable / neglect / assume ‘0’ (i.e., PCell) required to re-do all the PUCCH determination operation on PCell (i.e. to limit the UE complexity). We think that the simplest way to guarantee the RAN1#110 intended behavior would be to specify that the UE does not expect to be configured with any PUCCH repetition on PUCCH-sSCell. We think that this could be simpler than defining the UE to not expect any PUCCH repetition, and from gNB perspective would not really make any difference as the PUCCH-sSCell has a fully independent PUCCH configuration. ***Observation 1: To prevent a ‘first’ PUCCH repetition on PUCCH-sSCell, the simplest way would be to defined that the UE does not expect to be configured with any PUCCH resource with*** $N\_{PUCCH}^{repeat}>1$ ***on PUCCH-sSCell.***  |

**Moderator comments:**

* The HW suggestion implies that if the UE is determining a PUCCH resource with $N\_{PUCCH}^{repeat}>1$, the PCell needs to be indicated by the gNB.
	+ This would cover the case of ZTE based on moderator understanding as well, as if the PCell is anyhow indicated for the initial slot of PUCCH repetition – applying or not applying the pattern would not matter as this slot is associated with the PCell already.
	+ It would maybe better to use the inverse wording rewritten as ‘UE does not expect’ (as usually used in 3GPP) – such as: “***The UE does not expect to be indicated for a PUCCH transmission with*** $N\_{PUCCH}^{repeat}>1$ ***on PUCCH-sSCell based on the semi-static PUCCH switching pattern***”
* Nokia suggests to apply the restriction already by a RRC configuration restriction, that automatically would guarantee that the PCell is indicated (based on HW proposal). This is more restrictive that the HW suggestion, but the reason for the gNB to configure any PUCCH resource with PUCCH repetition in the PUCCH\_config of the PUCCH-sSCell, if such resource anyhow can never be used for the UE by the gNB.
* The ZTE wording based on the moderator assessment is not fully helping the case, as this would still allow for the initial slot the UE to determine a PUCCH resource with PUCCH repetition on PUCCH-sSCell which should then be deferred to a later slot, which based some earlier discussions and the RAN1#109-e agreement is not supported.

**Question 1.4: Which of the following company suggestions do you support?**

* **Alt. 1 (by ZTE):**
	+ **UE shall not ignore the PUCCH cell switching pattern in the initial slot if the first PUCCH repetition would be deferred from the initial slot.**
* **Alt. 2A (by HW):**
	+ **UE expects that PUCCH with repetitions are always indicated to transmit on PCell**
* **Alt. 2B (Mod reformulation of HW):**
	+ **The UE does not expect to be indicated for a PUCCH transmission with** $N\_{PUCCH}^{repeat}>1$ **on PUCCH-sSCell based on the semi-static PUCCH switching pattern**
* **Alt. 3 (Nokia):**
	+ **the UE does not expect to be configured with any PUCCH resource with** $N\_{PUCCH}^{repeat}>1$ **on PUCCH-sSCell**

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| Alt. 1  |  |
| Alt. 2A  | QC |
| Alt. 2B | Nokia/NSB (2nd preference) , Huawei, HiSilicon, QC, LG |
| Alt. 3 | Nokia/NSB (1st preference), Intel, CATT, Huawei, HiSilicon, QC(1st preference) ,OPPO, LG, ZTE |

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| *Company* | *Comments*  |
| vivo | Alt.3 seems is not relevant to the issues discussed by ZTE that how to determine the initial 1st repetition occasion, is it based on the nominal occasion even if the PUCCH collides with SSB/semi-static DL symbols, or the actual occasion where the 1st PUCCH is actually transmitted?Some Alternatives in Question 1.3 and Question 1.4 seems the same or have some overlapping.  |
| Moderator | @vivo: the intention here is to differentiate the ‘slot indicated by k1’ (handled in this question) and the slot of the 1st repetition (in Q 1.3). ZTE nicely pointed out that the slot of the 1st repetition may not be the slot where the UE determines that a PUCCH repetition is to take place (given by the initial slot). |
| QC | Restricting the first repetition starting on a Pcell would simply spec and also solve the issue raised by ZTE. So we supporting adding such restriction. Among the Alt 2A/2B/3, Alt 3, by RRC, is the simplest solution and we prefer it.  |
| ZTE | This issue is about the first PUCCH repetition collides with the SSB/Semi-static DL symbols, and defers to next available slot. How to treat the initial slot? Is it allowed to transmit scheduled PUCCH in sSCell? My thought is the time domain pattern is decided before the judgement of collision between PUCCH and SSB etc. As the pattern is ‘0’ already, UE shall not ignore the PUCCH cell switching pattern in the initial slot and no PUCCH will be transmitted on sSCell. Considering Alt.3 covers this thought, we can support Alt.3 for simplicity.  |
| Samsung | No apparent need for an agreement. Initial slot can be valid or invalid as in Rel-15.No reason for Alt.1, Alt.2A/2B is not possible, Alt.3 can be pre-empted by a possible agreement on the first topic/main issue. |

**Neglect for the full repetition bundle or slots with a valid PUCCH repetition only (according to Sec. 9.2.6 of 38.213)**

ZTE proposes to make the decision to apply the pattern per slot with a PUCCH repetition bundle whereas QC according to the RAN1#110 discussions on applying this for the overall PUCCH repetition bundle.

Two alternatives are discussed – with the following example figure showing the differences there: For slot N+1, there is a collision with SSB and therefore UE according to Sec. 9.2.6 determines there is no PUCCH repetition. Either based on Alt. 1, the pattern is neglected (based on the RAN1#110 discussions) or Alt. 2 as proposed by ZTE, where as there is no PUCCH repetition the UE does not apply the pattern:



**Question 1.5: For the RAN1#110 meeting solution (i.e. if the RAN1#110 meeting solution is adopted):**

* **Alt. 1 – based on RAN1#110 discussion (& QC input):** *Starting from a slot where a UE transmits the first repetition of a PUCCH until a slot where the UE transmits the last repetition of the PUCCH, the UE ignores the semi-static PUCCH cell switch pattern and transmits PUCCH (including PUCCH with repetitions and PUCCH without repetition) on Pcell.*
* **Alt. 2 – based on ZTE suggestion:**
	+ *For slots determined for PUCCH repetition based on TS 38.213 section 9.2.6, the UE ignores the semi-static PUCCH cell switch pattern and transmits PUCCH (including PUCCH with repetitions and PUCCH without repetition) on Pcell.*

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| Alt. 1  | Nokia/NSB, Intel, Huawei, HiSilicon, QC, OPPO, Samsung |
| Alt. 2  | CATT, LG, ZTE |

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| *Company* | *Comments*  |
| Intel  | we prefer Alt 1 for simplicity.  |
| vivo | Question 1.5 is related to Question 1.4 per our understanding, the key is how to determine the intial (norminal or actual) occasion for the 1st PUCCH repetition. |
| CATT | We prefer Alt 2. The intention of the PUCCH cell switching is to reduce the latency of PUCCH transmissions. Alt. 1 unnecessarily prevents some PUCCH transmissions on PUCCH sSCell which contradicts with the intention so that the latency is even worse than Option 1 (Alt. 2A of RAN1#108-e). Then how can the new proposal more agreeable? |
| Huawei, HiSilicon | Prefer Alt.1 for simplicity. But also fine with Alt.2 since it is better from latency perspective.  |
| Moderator | @vivo: there is some relation, but at least compared to Q 1.4, the problem is slightly different in terms of SR handling.  |
| LG | We prefer Alt. 2 for better performance and clear spec. But we also can live with Alt. 1 for the sake of the progress if most of companies want.  |
| ZTE | Share the view of CATT and LG. But we can live with Alt.1 if majority supports Alt.1. |

**Handling for slots where the UE neglects the pattern:**

**Huawei** discusses the following:

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| In addition, if the 3rd bullet is adopted, it should be clarified that the PUCCH/PUSCH multiplexing procedure in 9.2.5 and 9.2.6 happens for other PUCCHs without repetition after determining the PCell (which overrides the sSCell indicated by the PUCCH cell pattern).* ***For another scheduled/configured PUCCH without repetition, consider one of the following:***
	+ ***Opt1: if it occurs within the same PCell slot with the PUCCH repetition(s) other than the 1st repetition, UE transmits the scheduled/configured PUCCH also on the PCell regardless of the indication of the semi-static PUCCH cell pattern, and the multiplexing in clause 9.2.5 and 9.2.6 in 38.213 happens after determining the PCell***
	+ ***Opt2: UE does not expect the scheduled/configured PUCCH without repetition occurs within the same PCell slot with the PUCCH repetition(s) other than the 1st repetition if the PCell slot is indicated as sSCell by the semi-static PUCCH cell pattern.***
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**ZTE** discusses the following:

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| There is a special case that a non-repetitive PUCCH scheduled in a SCell slot overlapping with the SR PUCCH repetition in PCell slot. For example, referring to Figure 1, a HARQ-ACK PUCCH is scheduled in the 6th slot in the SCell slot based on the PUCCH cell switching pattern. After the PDSCH1, the UE triggers an SR PUCCH repetitions starting from the 5th slot in the PCell slot, and the SR PUCCH repetition2 is determined in the 6th slot in the PCell slot overlapping with the HARQ-ACK PUCCH in SCell slot. This case is inevitable as the SR triggering by UE is spontaneous.Following the conclusion that for slots with a PUCCH repetition the PUCCH cell pattern is not applicable, the non-repetitive PUCCH scheduled in advance should be cancelled. That is, in the example of Figure 1, the HARQ-ACK PUCCH in SCell should be cancelled. Obviously, the UE is expected to cancel the non-repetitive PUCCH transmission in a SCell slot before the first symbol of the SR PUCCH repetition in a PCell slot as the PUCCH cell pattern is not applicable for the slot. Due to the cancellation of HARQ-ACK PUCCH, whether to introduce a cancellation timeline for this case should be discussed further. Figure 1***Proposal 3:*** *For SR PUCCH repetition and PUCCH cell switching,** *If it is supported that for slots with a PUCCH repetition the PUCCH cell pattern is not applicable, the UE is expected to cancel the PUCCH transmission in a SCell slot before the first symbol of the SR PUCCH repetition in a PCell slot when the SCell slot overlaps with the PCell slot.*
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**QC** notes the following:

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| Proposal 1: Starting from a slot where a UE transmits the first repetition of a PUCCH until a slot where the UE transmits the last repetition of the PUCCH, the UE ignores the semi-static PUCCH cell switch pattern and transmits PUCCH (including PUCCH with repetitions and PUCCH without repetition) on Pcell. |

**In RAN1#110**, the following was discussed in this respect:

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| ….* The pattern not being applicable / neglected by the UE applies also for PUCCH transmissions without repetition when having an ongoing PUCCH repetition bundle and is applicable for scheduled PUCCH (through DCI) as well as for non-scheduled PUCCH.
	+ This is to prevent that there would be PUCCHs on PCell (through the repetition) and any other PUCCH in overlapping slot on PUCCH-sSCell.

…  |

**Moderator comments:**

* Option 1 from Huawei & the QC proposal seem to be fully aligned with the RAN1#110 intention /discussions. HW points out specifically the needed order of first determining PCell as the cell for transmission, and then applying 9.2.5 & 9.2.6 for that PCell slot.
* Option 2 from Huawei puts an additional gNB restriction, that the UE would basically not expect any PUCCH without repetition in slots where the pattern is not applied, and the pattern would have indicated the PUCCHs-sScell for transmission.
* ZTE specifically for the SR PUCCH repetition suggests to introduce a cancellation behavior for SR PUCCH which would require ‘PUCCH cell switching’ in a PCell slot even. Slightly unclear to the moderator if the same should also be applicable to any other PUCCH repetition or not.

But let’s try to get input by companies here. As the final outcome for which slots the pattern is not applied based on some discussions above, the moderator uses here the formulation:

**Question 1.6: For a slot where the UE neglects the semi-static PUCCH cell-switching pattern,**

* **Option 1 (HW / QC / RAN1#110):**
	+ **….the UE transmits scheduled/configured PUCCH without PUCCH repetition also on the PCell regardless of the indication of the semi-static PUCCH cell pattern, and the multiplexing in clause 9.2.5 and 9.2.6 in 38.213 happens after determining the PCell**
* **Option 2 (HW):**
	+ **… the UE does not expect scheduled/configured PUCCH without repetition if the PUCCH-sSCell is indicated by the semi-static PUCCH cell pattern for the slot**
* **Option 3 (ZTE)**
	+ **… the UE is expected to cancel a scheduled / configured PUCCH transmission without PUCCH repetition in a SCell slot before the first symbol of an SR PUCCH repetition in a PCell slot when the SCell slot overlaps with the PCell slot.**

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| Option 1 | Nokia/NSB, Intel, vivo, Huawei/HiSilicon, QC, OPPO |
| Option 2 |  |
| Option 3 | ZTE (Not only for SR, but also for others) |

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| *Company* | *Comments*  |
| Intel  | We agree with ZTE that UE may not have sufficient time to cancel PUCCH on Scell, if 1st SR repetition arrives quite late. But we also realize there is no specified timeline for SR in Rel-15/16/17. Considering limited time to close this issue, we prefer no special handling (e.g., option 2 or option 3) and it is up to UE implementation. We think the same principle is applid for Issue #6 (though here is cancellation, issue #6 is multiplexing) |
| CATT | Option 1 is complicated and in practice, we expect that PUCCH cannot be transmitted on PCell and that is why the semi-static PUCCH cell-switching pattern indicates PUCCH sSCell.Option 2 is difficult from gNB scheduling perspective since the PUCCH repetition can be dynamically scheduled.We agree with “**the UE is expected to cancel a scheduled / configured PUCCH transmission without PUCCH repetition in a SCell slot**” in Option 3. The before part seems to be only applicable to a specific case so that Option 3 is not complete? |
| QC | Option 2 and 3 seems unnecessarily adding restrictions to gNB or complicating UE behavior. In this case, Just falling back to Rel-15 and transmit all PUCCHs on Pcell is fine.  |
| LG | Option 1 may make burdens to UE and gNB. The gNB need to ensure scheduled PUCCH resource ID should work both PCell and PUCCH-sScell and UE need to change PUCCH resource as well as PUCCH carrier if a PUCCH was determined as repetitions in the previous slot. If it would be an issue, we support Option 3. If there is no UE implementation issue for changing PUCCH cell and PUCCH resource in time, we can support Option 1.  |
| ZTE | Agree with CATT. Actually we propose to cancel the scheduled / configured PUCCH transmission without PUCCH repetition in a SCell slot no matter what the PUCCH repetition in a PCell slot is for SR or not. For the multiplexing in Alt. 1, one issue is there is a risk to determine a suitable PUCCH resource in PCell based on the PRI for the PUCCH in Scell. As the resource in PCell and Scell are individually configured, if the the PUCCH resource determined by the PRI for the PUCCH in Scell is PUCCH format 1, but the PUCCH resource determined by the PRI is PUCCH format 0, how to do the multiplexing. This risk is clearer if SR PUCCH repetition is in PCell. |
| Samsung | For Option 1, given that no other UCI is multiplexed in a PUCCH with repetitions (and that PUCCH is prioritized) a clarification is requested on the reference to the multiplexing procedures in 9.2.5 and 9.2.6. Also, the PUCCH resource determination for PUCCHs without repetitions needs to be discussed – e.g. should a gNB configure PUCCH resources on both the PCell and the PUCCH-sSCell just to cover the case that there may be another PUCCH with repetitions? |

**Granularity of the decision to not apply / neglect the pattern – per PCell slot or slot of the reference SCS configuration:**

For the case, that the reference SCS is smaller than the PCell SCS, there is more than one overlapping PCell slot per PUCCH cell indication. Although, this may only be a corner case (as usually the reference SCS may be the PCell SCS) but still some handing would need to be defined there as well also affecting the specification (… is the pattern neglected per PCell slot as in some companies formulation of the proposals, or per UL slot of the reference SCS configuration:

**Nokia** discusses the following:

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| An example is shown in Figure 1 below, where it is not clear when the PCell has different SCS from the reference SCS for PUCCH cell switching pattern if the UE should transmit PUCCH on Pcell or PUCCH-sSCell in slot #7 (not containing any PUCCH repetition but the pattern indicating the PUCCH-sSCell).***Figure 1: Handling of different slot length of PCell and reference SCS***Clearly two options can be there to define the handling for slot#7: * Option 1: The ‘decision’ to apply the pattern or to neglect the pattern is done per PCell (PUCCH) slot
	+ Note: this means, for slot #7 in the figure above the pattern is applicable and the UE transmits the PUCCH (if any) on the PUCCH-sSCell
	+ Note: this would lead to a PUCCH cell switch during an UL slot of the reference SCS configuration (i.e. switching with higher granularity that the time-domain pattern).
* Option 2: The ‘decision’ to apply the pattern or to neglect the pattern is done per UL slot of the reference SCS configuration (i.e. the granularity of the time-domain pattern)
	+ Note: this means, for slot #7 in the figure above the pattern is not applicable and the UE transmits the PUCCH (if any) on the PCell (and neglects the pattern, although there is no PUCCH of repetition within the PCell UL slot).

Clearly both options are valid, but we think that it would be better to limit the PUCCH switching points aligned with the time-domain pattern granularity. ***Observation 2: Having the UE to neglect / not apply the PUCCH cell pattern for UL slots of the reference SCS configuration with a PUCCH transmission with*** $N\_{PUCCH}^{repeat}>1$ ***as determined in Sec. 9.2.6 of TS 38.213 (compared to decision per PCell PUCCH slot) would simplify the specification effort and guarantee the PUCCH cell switching times aligned with the time-domain pattern granularity.***  |

**Moderator comments:**

* In addition to the scenario of different SCS discussed by Nokia, there is of course also the issues of different sub-slot length for the 1st and 2nd PUCCH cell group on PCell, that would leave ambiguity there if the operation is done per PCell slot of a certain PHY priority. And clearly, both priorities need to be considered when determining that the time-domain pattern is not applied – as also discussed by Nokia in their contribution as

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| So far, the description of semi-static PUCCH cell switching in Sec. 9.A of 38.213 does not really consider different PHY priorities, as the pattern would be applicable for both PHY priorities / PUCCH configurations (first & second). But now for the intended operation for PUCCH repetition, as long as there is a pending PUCCH repetition of either PHY priority (started in a previous slot) the UE would need to ‘neglect / not apply’ the time-domain pattern, as the PHY prioritization operation is only to happen after the determination of the cell for PUCCH transmission. ***Observation 4: The decision to neglect / not apply the PUCCH cell pattern is to be based on the (pending) PUCCH repetitions of both priorities jointly, to guarantee the pattern is equally applied for either PHY priority.***  |

* So from moderator perspective, having this per PCell (PUCCH) slot and not per UL slot of the reference SCS configuration may be the simpler (although somehow might claim non-optimial solution

Therefore, let’s check which options is preferred – per PCell slot or per UL slot of the reference SCS configuration:

**Question 1.7: The ‘decision’ to apply the pattern or to neglect the pattern is done per:**

* **Option 1: PCell (PUCCH) slot**
	+ **Note: this means, for slot #7 in the figure by Nokia above the pattern is applicable and the UE transmits the PUCCH (if any) on the PUCCH-sSCell**
	+ **Note: this would lead to a PUCCH cell switch during an UL slot of the reference SCS configuration (i.e. switching with higher granularity that the time-domain pattern).**
* **Option 2: UL slot of the reference SCS configuration (i.e. the granularity of the time-domain pattern)**
	+ **Note: this means, for slot #7 in the figure by Nokia above the pattern is not applicable and the UE transmits the PUCCH (if any) on the PCell (and neglects the pattern, although there is no PUCCH of repetition within the PCell UL slot).**

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| Option 1 | CATT (1st preference), QC, LG |
| Option 2 | Nokia/NSB, Intel , vivo, CATT (2nd preference), Huawei/HiSilicon, QC, OPPO, ZTE, Samsung |

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| --- | --- |
| *Company* | *Comments*  |
| vivo | Option 2 is simpler.  |
| QC | Regarding the options, both can work. We slightly prefer option 1.  |
| LG | We slightly prefer Option 1. Since both works, we can also live with Option 2.  |
|  |  |

**Discussion on TPs:**

**For Alt. 2A (if Alt. 2A is to be adopted):**

There had not been any TP / CR provided by companies suggesting adopting Alt. 2A, but to see the specification impact, the moderator provided the following example here:

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| 9.2.6 PUCCH repetition procedure**< Unchanged parts are omitted >**For unpaired spectrum, the UE determines the $N\_{PUCCH}^{repeat}$ slots for a PUCCH transmission starting from a slot indicated to the UE as described in clause 9.2.3 for HARQ-ACK reporting, or a slot determined as described in clause 9.2.4 for SR reporting or in clause 5.2.1.4 of [6, TS 38.214] for CSI reporting and having- an UL symbol, as described in clause 11.1, or flexible symbol that is not SS/PBCH block symbol provided by *startingSymbolIndex* as a first symbol, and- consecutive UL symbols, as described in clause 11.1, or flexible symbols that are not SS/PBCH block symbols, starting from the first symbol, equal to or larger than a number of symbols provided by *nrofsymbols*, and- the PCell indicated as the cell for PUCCH cell transmission according to clause 9.A if the UE is provided *pucch-sSCellPattern*.**< Unchanged parts are omitted >** |

Any comments welcome here:

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| *Company* | *Comments*  |
| QC | Regarding this: “the PCell indicated as the cell for PUCCH cell transmission according to clause 9.A”, is the intention to call this cell indicated by the pattern for the 1st PUCCH repetition transmission so that we can following whatever procedure defined in section 9, which is defined for the “PCell”?  |
| LG | Just for editorial. We have following suggestion. the indication that PCell is the cell for PUCCH transmission according to clause 9.A if the UE is provided *pucch-sSCellPattern*. |
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**For RAN1#110 mode (if to be adopted):**

It may be a bit early in the 1st round to discuss the TP directly already, as at least some of the needed clarifications of the questions above may have an effect on the final TP here.

Nevertheless, if there are any early comments here in general – this can be taken into account then later on more efficiently. So input by companies here would be appreciated!

The moderator marked the different parts in different colors, to try to discuss a bit the differences & communalities here:

Ericsson providing the following draft CR in [**R1-2210142**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210142.zip):

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| 9.A PUCCH cell switchingThis clause is applicable when a UE is provided a PUCCH-sSCell by *pucch-sSCell* and the PUCCH-sSCell is activated and does not have a dormant UL/DL active BWP. A UE can be provided a periodic cell switching pattern for PUCCH transmissions by *pucch-sSCellPattern.* Each bit of the pattern corresponds to a slot for a reference SCS configuration provided by *tdd-UL-DL-ConfigurationCommon* for the PCell with a value of '0' or a value of '1' indicating, respectively, the PCell or the PUCCH-sSCell as the cell for PUCCH transmissions during the slot of the reference SCS configuration. For slots of the reference SCS configuration with PUCCH transmissions of any priority, starting from a slot where the UE would transmit a first repetition of a PUCCH until a slot where the UE would transmit a last repetition of the PUCCH as described in Clause 9.2.6, the UE does not apply the provided pattern and transmits the PUCCHon the PCell. The UE does not transmit a PUCCH in a slot on a cell if the pattern indicates a different cell for PUCCH transmission during the slot. A slot on the active UL BWP of the PUCCH-sSCell does not overlap with more than one slot on the active UL BWP of the PCell. If a slot for the active UL BWP of the PCell overlaps with more than one slot on the active BWP of the PUCCH-sSCell and the UE would transmit a PUCCH on the PUCCH-sSCell, the UE considers the first of the overlapping slots for the PUCCH transmission on the PUCCH-sSCell.**< Unchanged parts are omitted >** |

Nokia / NSB providing the following draft CR in [**R1-2210147**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210147.zip):

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| 9.A PUCCH cell switchingThis clause is applicable when a UE is provided a PUCCH-sSCell by *pucch-sSCell* and the PUCCH-sSCell is activated and does not have a dormant UL/DL active BWP. A UE can be provided a periodic cell switching pattern for PUCCH transmissions by *pucch-sSCellPattern.* Each bit of the pattern corresponds to a slot for a reference SCS configuration provided by *tdd-UL-DL-ConfigurationCommon* for the PCell with a value of '0' or a value of '1' indicating, respectively, the PCell or the PUCCH-sSCell as the cell for PUCCH transmissions during the slot of the reference SCS configuration. For slots of the reference SCS configuration with PUCCH transmissions of any PHY priority, starting from a slot where the UE would transmit a first repetition of a PUCCH of a PHY priority until a slot where the UE would transmit the last repetition of the PUCCH as described in Clause 9.2.6, the UE does not apply the provided pattern but determines the PCell as the cell for PUCCH transmission. The UE ~~does not~~neither processes nor transmits a PUCCH in a slot on a cell if the pattern indicates a different cell for PUCCH transmission during the slot. A slot on the active UL BWP of the PUCCH-sSCell does not overlap with more than one slot on the active UL BWP of the PCell. If a slot for the active UL BWP of the PCell overlaps with more than one slot on the active BWP of the PUCCH-sSCell and the UE would transmit a PUCCH on the PUCCH-sSCell, the UE considers the first of the overlapping slots for the PUCCH transmission on the PUCCH-sSCell. The UE does not expect to be configured with any PUCCH resource with $N\_{PUCCH}^{repeat}>1$ on the PUCCH-sSCell.**< Unchanged parts are omitted >** |

Moderator comments:

* The common parts of the TPs of Ericsson & Nokia include (not marked in color)
	+ ‘Starting from a slot till a last slot’ – this may be affected by the discussions still around Questions 1.1, 1.2 and 1.3
	+ The joint determination of to apply (or not apply / neglect) the pattern across PHY priorities
	+ The determination per slot of the reference SCS configuration – see the discussion on the options in Question 1.5
* The differences between Ericsson & Nokia are marked in colors)
	+ Additional of a PHY priority by Nokia: editorial difference only – but no functional difference.
	+ Blue parts: Slightly different formulation that may be also affected by the discussion around Question 1.4 (behavior in a slot where the pattern has been neglected)
	+ The green part by Nokia: Nokia highlighted in their contribution, that based on the current formulation the UE may still process / prepare a PUCCH before checking the PUCCH cell switching pattern (and then decides to not transmit) which may create some ambiguity here – see also the comments by Huawei that the cell determination is to be done before 9.2.5 & 9.2.6.
	+ The grey part by Nokia: This is related also to Question 1.4 – and depends on the outcome of the discussions there

Any comments welcome here:

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| *Company* | *Comments*  |
| Samsung | Support the TP from Ericsson.The grey part in the TP from Nokia is unnecessary regardless of Q 1.4. |
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**For RAN1#109 mode (if to be adopted):**

Moderator uses some example TP discussed in RAN1#110 here:

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| 9.A PUCCH cell switchingThis clause is applicable when a UE is provided a PUCCH-sSCell by *pucch-sSCell* and the PUCCH-sSCell is activated and does not have a dormant UL/DL active BWP. A UE can be provided a periodic cell switching pattern for PUCCH transmissions by *pucch-sSCellPattern.* Each bit of the pattern corresponds to a slot for a reference SCS configuration provided by *tdd-UL-DL-ConfigurationCommon* for the PCell with a value of '0' or a value of '1' indicating, respectively, the PCell or the PUCCH-sSCell as the cell for PUCCH transmissions during the slot of the reference SCS configuration. The UE does not transmit a PUCCH in a slot on a cell if the pattern indicates a different cell for PUCCH transmission during the slot. A slot on the active UL BWP of the PUCCH-sSCell does not overlap with more than one slot on the active UL BWP of the PCell. If a slot for the active UL BWP of the PCell overlaps with more than one slot on the active BWP of the PUCCH-sSCell and the UE would transmit a PUCCH on the PUCCH-sSCell, the UE considers the first of the overlapping slots for the PUCCH transmission on the PUCCH-sSCell. For slots with PUCCH transmission(s) on PCell with repetition of >1 according to clause 9.2.6, the UE does not except to be indicated with a value of ‘1’ by the *pucch-sSCellPattern*. |

Any comments welcome here:

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| *Company* | *Comments*  |
| ZTE | Fine |
| Samsung | Not a comment on the TP itself, but the operation described in the TP is not possible in any existing or conceivable deployment. |
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* 1. 2nd round of email approvals

Looking at which scheme to support in Question 1.1,

* there seems to be more companies supporting Alt. 2A (10 companies) than the others
	+ companies seems to be aware that there will be some ‘delay’ of the overall repetition bundle but at the cost of lower implementation & specification complexity (as pointed out by several companies)
* the RAN1#110 intended mode (that needs further clarification / design decisions) received also good support (8 companies)
* only minority support for the RAN1#109-e mode (so no real motivation to continue discussing this option here)

So, let’s see if we can agree Alt. 2A (receiving most support) here in the 2nd round by email (and would then work on the TP for it in the 3rd round) – supporting companies from Sec. 1.4 are pre-filled.

**Proposal 1.5.1 for email approval: PUCCH repetition for semi-static PUCCH switching is supported**

**according to Alt. 2A of the RAN1#108/109-e discussions**, **i.e.**

* + ***For semi-static PUCCH cell switching, a PUCCH repetition transmission on a different target PUCCH cell from the PUCCH cell of the first PUCCH repetition is not supported***
		- ***A PUCCH slot mapped to different PUCCH cell is considered as invalid for PUCCH repetition and is not counted towards the total number of PUCCH repetitions, i.e., the repetition is postponed as in Rel-16.***
		- ***PUCCH repetitions are only applicable on PCell, PScell, and PUCCH SCell.***

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| Support:  | Nokia/NSB, Intel, vivo, CATT, Huawei/HiSilicon, QC, New H3C, OPPO, LG, ZTE |
| Object:  | Samsung |

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| *Company* | *Comments*  |
| CATT | We support the proposal.Samsung provided the following comment in the 1st round:*Alt.2A can be worse than the “RAN1#110 mode” for the latency of a PUCCH transmission with repetitions (can never be better).*We have not identified practical case that “RAN1#110 mode” can be better than Alt.2A in terms of latency and appreciate if Samsung can share the case they have in mind.Based on the discussions, companies including Samsung prefer Alt. 1 for Question 1.5, which prevents UE to transmit PUCCH on PUCCH sSCell in slot #n+1 while it is allowed according to Alt.2A. So we see that the latency of “RAN1#110 mode” is even worse than Alt.2A. |
| QC | We support this proposal. As for the cost of latency, comparing to not enabling semi-static PUCCH switch, the latency of PUCCH repetition is the same, given PUCCH repetitions is on Pcell anyway. Then semi-static switch can at least reduce the latency for PUCCH without repetitions. So there is still benefit of latency reduction.  |
| Samsung | Alt.2A can result to worse latency than the “RAN1#110 mode” due to the following * *A PUCCH slot mapped to different PUCCH cell is considered as invalid for PUCCH repetition and is not counted towards the total number of PUCCH repetitions, i.e., the repetition is postponed as in Rel-16.*

That would result to the UE not transmitting a repetition on the PCell because the pattern indicates the PUCCH-SCell for that slot (the slot can support repetition on the PCell) or constraining the gNB configuration for the pattern. Therefore, as the objective is minimization of HARQ-ACK latency and channels with repetitions are prioritized, there is no benefit of Alt.2A over the “RAN1#110 mode”. |
| CATT | Thanks Samsung for clarification. Then it seems that the case that “RAN1#110 mode” is bettern than Alt. 2A is when PUCCH repetition can be transmitted on PCell but the pattern indicates PUCCH-sSCell for that slot. But why would gNB configure in that way? If it may happen, why we restrict in both proposals that PUCCH repetition can only occur on PCell if we really want to reduce the latency of PUCCH repetition? |
| LG | Support the proposal. Comparing to RAN1#110 mode, Alt. 2A has less issues and better resource availability, which is main purpose of PUCCH carrier switching.  |
| ZTE | @Samsung, CATT, FL. It seems we are in the deadlock among the soultions of 2A, 110meeting and 109 meeting.Can we take a simple way to solve the concern on each solution?Based on the proposal in #109, we can have a conclusion that: “For slots with PUCCH transmission(s) on PCell with repetition of >1 according to clause 9.2.6, the UE does not except to be indicated with a value of ‘1’ by the *pucch-sSCellPattern*.”. But the conclusion doesn’t need to be captured in the specification. We only need to capture UE follows the rule of Rel-15/16 for PUCCH repetition in the below TP.The changes in section 9.A mean that the base station cannot configure PUCCH resources with PUCCH repetitions in the SCell. The base station can easily achieve the above configuration after the frame structure is determined. The base station should configure PUCCH cell on the PCell to ensure UE can reuse of R15/16 rules. For example, if a PCell slot is a UL slot (or a slot containing flexible symbols), the PCell should be configured as PUCCH cell during the PCell slot. This can be implemented as a base station and there is no impact on the specification.If gNB can’t ensure the configuration, gNB can have the freedom to release the coupling between PUCCH repetition and PUCCH cell switching.**TP**:

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| 9.A PUCCH cell switchingThis clause is applicable when a UE is provided a PUCCH-sSCell by *pucch-sSCell* and the PUCCH-sSCell is activated and does not have a dormant UL/DL active BWP. A UE can be provided a periodic cell switching pattern for PUCCH transmissions by *pucch-sSCellPattern.* Each bit of the pattern corresponds to a slot for a reference SCS configuration provided by *tdd-UL-DL-ConfigurationCommon* for the PCell with a value of '0' or a value of '1' indicating, respectively, the PCell or the PUCCH-sSCell as the cell for PUCCH transmissions during the slot of the reference SCS configuration. The UE does not transmit a PUCCH in a slot on a cell if the pattern indicates a different cell for PUCCH transmission during the slot. A slot on the active UL BWP of the PUCCH-sSCell does not overlap with more than one slot on the active UL BWP of the PCell. If a slot for the active UL BWP of the PCell overlaps with more than one slot on the active BWP of the PUCCH-sSCell and the UE would transmit a PUCCH on the PUCCH-sSCell, the UE considers the first of the overlapping slots for the PUCCH transmission on the PUCCH-sSCell. If the UE is provided *PUCCH-sSCellPattern*, UE transmits a PUCCH over $N\_{PUCCH}^{repeat}>1$ slots according to 9.2.6. |

 |
| Moderator | @ZTEthanks for the proposal. To your paragraph in yellow: I guess we discussed this in Toulouse – that gNB guarantees the PCell is ‘configured’ for UL slots with the repetitions – and you just laid out nicely how the gNB could be guaranteeing that. **The issue:** Please note that Samsung also objected to that, as Samsung argument has been the gNB will not be able to guarantee this.What I didn’t fully get is your paragraph in magenta: What do you mean with’release the coupling’ – you mean gNB would not use / configure / apply the feature combination? |
| ZTE | @Moderator: Reply the yellow part: Yes, the release is NOT apply the feature combination.This thought is from proposal 1.1. Can we let the gNB to select the choice? I know in this stage, maybe no way for gNB to configure something new. Just a possible way. |
| Huawei, HiSilicon | For the case that PUCCH cannot be transmitted on PCell, which is very likely the typical case for PUCCH switching, indeed Alt. 2A here is better from latency perspective.  |
| LG | We are bit confused with ZTE’s TP. UE behavior in 9.2.6 based on the determined cell. Thus, UE needs to determine a cell first. Does it allow to transmit PUCCH repetition on PUCCH-sSCell? Even if we assumes that PCell is considered for 9.2.6, this way seems only works when gNB configure the pattern as ‘0’ for all UL slot for the PUCCH in a PCell. First of all, it is difficult to determine “UL slot” before the scheduling PUCCH, since valid UL slot are dependant to PUCCH resource in 9.2.6. And we cannot sure it is desirable to force to use PCell everytime even when there are empty resource for PUCCH in PUCCH-sSCell. If the TP is to work with another TP for Alt.2 A below. We are fine with the TP.  |

* 1. 2nd round of email discussions

In the 2nd round, I plan to discuss there the following:

* If Alt. 2A is not acceptable in the 2nd round of email discussions, the next thing would be to check the RAN1#110-e mode details (on parallel) based on the input given in the 1st round to be prepared (but the moderator is hopefull that we can get Alt. 2A accepted, which should make things easier. So the discussions here are clearly conditional.
* Potential TP assuming Alt. 2A (continuation from the 1st round)

**Details of RAN1#110-e mode:**

There had been good input on the questions of the RAN1#110-e operation.

Based on the input given, the moderator tries to summarize the resulting operation (using majority input based on each of the issues discussed in the 1st round as).

**Proposal 1.6.1: If the RAN1#110-e mode would be adopted, PUCCH repetition for semi-static PUCCH switching is supported based on the following operation:**

* **the UE does not expect to be configured with any PUCCH resource with** $N\_{PUCCH}^{repeat}>1$ **on PUCCH-sSCell**
* **the UE does not expect to be indicated by the semi-static PUCCH cell pattern as sSCell on the slot of the 1st PUCCH repetition**
* **for UL slots of the reference SCS configuration starting from the slot ~~with the 2~~~~nd~~ after the 1st PUCCH repetition till the slot with the last PUCCH repetition:**
	+ **the UE always transmits the PUCCH repetition on PCell regardless of the indication of the semi-static PUCCH cell pattern**
	+ **the UE transmits scheduled/configured PUCCH without PUCCH repetition also on the PCell regardless of the indication of the semi-static PUCCH cell pattern, and the multiplexing in clause 9.2.5 and 9.2.6 in 38.213 happens after determining the PCell**

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| Support:  | New H3C, vivo ZTE(can accept), Nokia/NSB, Huawei/HiSilicon |
| Object:  | QC(not real object. But have a question for clarification), Samsung |

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| *Company* | *Comments*  |
| CATT | Based on the proposal, as commented above, UE is not allowed to be transmitted on PUCCH sSCell and for the most practical case, the PUCCH resources in those slots are not available on PCell which lead to longer latency.So we really have difficulty to understand the logic to go with this proposal. |
| QC | @FL, we have a question regarding “**starting from the slot with the 2nd PUCCH repetition**”: why starting from second repetition? I thought in the discussion in the first round, the majority view is in the boundle from the first repetition to the last repetition, UE ignore the pattern. If staring from the second repetition, then that means in the slots between the first repetition and second repetition (say if the second repetition is delayed due to colliding with SSB), UE need to follow the pattern to transmit PUCCH without repetition on Scell on those slots? That seems a little strange. Can FL please clarify is that a typo? |
| Moderator | @QC: point taken – I guess it should be ‘starting from the slot after the 1st PUCCH repetition’ (as there could be further deferral) as the slot of the 1st PUCCH repetition itself, the UE still assumes the pattern to be indicated (on neglect/skip pattern). Hope I fixed this now correctly in red… |
| Vivo | Thanks moderator’s explaintion in the 1st round. Our understanding is for the 1st PUCCH repetition from the occasion that indicated by k1 to the occasion that actually transmitted (due to deferral), gNB needs to ensure the pattern should indicate Pcell; after the 1st repetition, then UE can ignore the pattern until the repetition is finished.  |
| ZTE | For the multiplexing process of last sub-bullet, as LG mentioned, if the gNB can ensure scheduled PUCCH resource ID be workable for both PCell and PUCCH-sScell, we can accept the proposal. |
| Samsung | The restrictions of the proposal are not necessary, none of them exists for PUCCH repetitions in Rel-15, and there is no new issue – the UE and the gNB know how the transmission will be without ambiguity. |
|  |  |

**TP for Alt. 2A (if Alt. 2A can be agreed – continution from 1st round):**

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| 9.A PUCCH cell switchingThis clause is applicable when a UE is provided a PUCCH-sSCell by *pucch-sSCell* and the PUCCH-sSCell is activated and does not have a dormant UL/DL active BWP. A UE can be provided a periodic cell switching pattern for PUCCH transmissions by *pucch-sSCellPattern.* Each bit of the pattern corresponds to a slot for a reference SCS configuration provided by *tdd-UL-DL-ConfigurationCommon* for the PCell with a value of '0' or a value of '1' indicating, respectively, the PCell or the PUCCH-sSCell as the cell for PUCCH transmissions during the slot of the reference SCS configuration. The UE does not transmit a PUCCH in a slot on a cell if the pattern indicates a different cell for PUCCH transmission during the slot. A slot on the active UL BWP of the PUCCH-sSCell does not overlap with more than one slot on the active UL BWP of the PCell. If a slot for the active UL BWP of the PCell overlaps with more than one slot on the active BWP of the PUCCH-sSCell and the UE would transmit a PUCCH on the PUCCH-sSCell, the UE considers the first of the overlapping slots for the PUCCH transmission on the PUCCH-sSCell. The UE does not expect to be configured with any PUCCH resource with $N\_{PUCCH}^{repeat}>1$ on the PUCCH-sSCell.If a UE is provided *pucch-sSCellDyn* or *pucch-sSCellDynDCI-1-2*, a corresponding DCI format associated with generation of HARQ-ACK information by the UE can include a PUCCH cell indicator field [5, TS 38.212] with a value of '0' or a value of '1' indicating, respectively, whether a PUCCH transmission with the HARQ-ACK information by the UE is on the PCell or on the PUCCH-sSCell. When the UE transmits a PUCCH with HARQ-ACK information that is associated only with SPS PDSCH receptions, the UE transmits the PUCCH on the PCell. The UE does not expect the PUCCH cell indicator field to indicate the PUCCH-sSCell for a PUCCH transmission in a slot that overlaps with a slot on the PCell where the UE would transmit another PUCCH of same or different priority index.**< Unchanged parts are omitted >**9.2.6 PUCCH repetition procedure**< Unchanged parts are omitted >**For unpaired spectrum, the UE determines the $N\_{PUCCH}^{repeat}$ slots for a PUCCH transmission starting from a slot indicated to the UE as described in clause 9.2.3 for HARQ-ACK reporting, or a slot determined as described in clause 9.2.4 for SR reporting or in clause 5.2.1.4 of [6, TS 38.214] for CSI reporting and having- an UL symbol, as described in clause 11.1, or flexible symbol that is not SS/PBCH block symbol provided by *startingSymbolIndex* as a first symbol, and- consecutive UL symbols, as described in clause 11.1, or flexible symbols that are not SS/PBCH block symbols, starting from the first symbol, equal to or larger than a number of symbols provided by *nrofsymbols*, and- the ~~PCell~~ indication~~ed as~~ that PCell is the cell for PUCCH cell transmission according to clause 9.A if the UE is provided *pucch-sSCellPattern*.**< Unchanged parts are omitted >** |

**Question 1.6.X: If Alt. 2A is adopted, do you support the TP above?**

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| Yes | CATT, QC, Intel, vivo, ZTE(in principle), Huawei |
| No | Samsung |

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| *Company* | *Comments*  |
| QC | Regarding this: “the PCell indicated as the cell for PUCCH cell transmission according to clause 9.A”, is the intention to call this cell indicated by the pattern for the 1st PUCCH repetition transmission so that we can following whatever procedure defined in section 9, which is defined for the “PCell”?  |
| LG | Just for editorial. We have following suggestion. the indication that PCell is the cell for PUCCH transmission according to clause 9.A if the UE is provided *pucch-sSCellPattern*. |
| ModeratorContinuation in 2nd round | Updates in the 2nd round in green!@QC: the intention is that actually the UE can apply the pattern as it is, as only slots indicated as ‘PCell’ are possible slots where the PUCCH repetition is to be mapped (slots with PUCCH-sSCell are excluded from the set of potential slots for PUCCH repetition). We may still need some clarification in 9.A saying no PUCCH resource with PUCCH repetition in 9.A – but I guess otherwise, all should be there. I guess the same should be there as well as for the RAN1#110 mode (to prevent the issue of the repetition) – which I now added for Sec. 9.A as well. @LG – changed based on your proposal  |
| QC | Thank FL for the clarification. The most recent TP looks good to me.  |
| Intel  | We are fine with the updated TP.  |
| ZTE | My suggestion is to reuse the original wording in the 2A, to avoid the different understanding. But I will not object the current wording.Possible revision:

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| For unpaired spectrum, the UE determines the $N\_{PUCCH}^{repeat}$ slots for a PUCCH transmission starting from a slot indicated to the UE as described in clause 9.2.3 for HARQ-ACK reporting, or a slot determined as described in clause 9.2.4 for SR reporting or in clause 5.2.1.4 of [6, TS 38.214] for CSI reporting and having- an UL symbol, as described in clause 11.1, or flexible symbol that is not SS/PBCH block symbol provided by *startingSymbolIndex* as a first symbol, and- consecutive UL symbols, as described in clause 11.1, or flexible symbols that are not SS/PBCH block symbols, starting from the first symbol, equal to or larger than a number of symbols provided by *nrofsymbols*, and~~- the PCell indicationed as that PCell is the cell for PUCCH cell transmission according to clause 9.A if the UE is provided~~ *~~pucch-sSCellPattern~~*~~.~~If the UE is provided PUCCH-sSCellPattern and if a PUCCH slot mapped to different PUCCH cell, the slot is invalid as PUCCH repetition and is not counted towards the total number of PUCCH repetitions. |

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| Nokia | @ZTE: if we go for your proposal, this operation is a bit circular. The first paragraph defines which slots are selected and we say – the slot is invalid. I guess this was the intention to have this is one go / paragraph which should describe the behavior.  |
| Samsung | In addition to Alt.2A, the “UE does not expect …” error condition is not necessary. |
| LG | Thanks for the update. We are fine with the TP. Regarding the error case, we think it is good to have, though it may not be necessary.  |

* 1. 3rd round of email approvals

To be very honest here, the moderator is running out of ideas at this point of time – considering the status after the 2nd round:

* Alt. 2 A (as in earlier meetings) is objected by Samsung based on the ‘latency’, in case the gNB would configure slots for PUCCH-sSCell where actually the PUCCH on PCell would have been available as well
	+ See the comments by companies there in 2nd round in Sec. 1.5
* RAN1#110 intention:
	+ We tried to work out some further details in the 1st round, that Samsung is not OK with in the second round (see Sec. 1.6)
	+ Nobody so far objected to this operation mode – but this may be very much depending on the details there as well.
	+ So moderator has no other ‘idea’ on this way to check if we could go for the RAN1#110 intention without the related restrictions.
* ZTE explaining that we should check once again – if we could not go for what had been discussed earlier: gNB to guarantee that PCell is indicated for slots where the UE would based on 9.2.6 transmit a PUCCH repetition on PCell
	+ Moderator comments:
		- this had been also objected by Samsung in RAN1#110 (Toulouse), where the argument had been the gNB cannot really guarantee that.
		- Clearly the gNB (if not being able to guarantee that) could not configure the feature combination, but then if the gNB is able to guarantee – then this basically is the same as in Alt. 2A (as there would not be any slots where the PUCCH repetition on PCell would be transmitted earlier). So in this respect, Alt. 2A & this leads to the same ‘latency’ in case the gNB can guarantee the low latency, wheres Alt. 2A would still enable the case the gNB is not able to guarantee the PCell

**So – as running out of ideas, the moderator tries / does the following in the 3rd round:**

* I copy here the Alt. 2A still – knowing that Samsung objected, but to have it still here (from 2nd round)
* Check if we can go for the RAN1#110 intention, without the restrictions / further clarifications objected by Samsung in the 2nd round
* Check the ZTE still one more time as well – maybe there is a surprise. Let’s see if we can agree the TP directly there provided by ZTE.

**Clearly: If we don’t get out of this round with an agreement on the way / mode to support this, the next & only option the moderator sees would be to revert the earlier agreement to support the feature combination in the following round.**

**Alt. 2A (continuation, as mentioned – mainly to have in one place)**

**Proposal 1.5.1 for email approval: PUCCH repetition for semi-static PUCCH switching is supported**

**according to Alt. 2A of the RAN1#108/109-e discussions**, **i.e.**

* + ***For semi-static PUCCH cell switching, a PUCCH repetition transmission on a different target PUCCH cell from the PUCCH cell of the first PUCCH repetition is not supported***
		- ***A PUCCH slot mapped to different PUCCH cell is considered as invalid for PUCCH repetition and is not counted towards the total number of PUCCH repetitions, i.e., the repetition is postponed as in Rel-16.***
		- ***PUCCH repetitions are only applicable on PCell, PScell, and PUCCH SCell.***

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| Support:  | Nokia/NSB, Intel, vivo, CATT, Huawei/HiSilicon, QC, New H3C, OPPO, LG, ZTE |
| Object:  | Samsung |

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| *Company* | *Comments*  |
| CATT | We support the proposal.Samsung provided the following comment in the 1st round:*Alt.2A can be worse than the “RAN1#110 mode” for the latency of a PUCCH transmission with repetitions (can never be better).*We have not identified practical case that “RAN1#110 mode” can be better than Alt.2A in terms of latency and appreciate if Samsung can share the case they have in mind.Based on the discussions, companies including Samsung prefer Alt. 1 for Question 1.5, which prevents UE to transmit PUCCH on PUCCH sSCell in slot #n+1 while it is allowed according to Alt.2A. So we see that the latency of “RAN1#110 mode” is even worse than Alt.2A. |
| QC | We support this proposal. As for the cost of latency, comparing to not enabling semi-static PUCCH switch, the latency of PUCCH repetition is the same, given PUCCH repetitions is on Pcell anyway. Then semi-static switch can at least reduce the latency for PUCCH without repetitions. So there is still benefit of latency reduction.  |
| Samsung | Alt.2A can result to worse latency than the “RAN1#110 mode” due to the following * *A PUCCH slot mapped to different PUCCH cell is considered as invalid for PUCCH repetition and is not counted towards the total number of PUCCH repetitions, i.e., the repetition is postponed as in Rel-16.*

That would result to the UE not transmitting a repetition on the PCell because the pattern indicates the PUCCH-SCell for that slot (the slot can support repetition on the PCell) or constraining the gNB configuration for the pattern. Therefore, as the objective is minimization of HARQ-ACK latency and channels with repetitions are prioritized, there is no benefit of Alt.2A over the “RAN1#110 mode”. |
| CATT | Thanks Samsung for clarification. Then it seems that the case that “RAN1#110 mode” is bettern than Alt. 2A is when PUCCH repetition can be transmitted on PCell but the pattern indicates PUCCH-sSCell for that slot. But why would gNB configure in that way? If it may happen, why we restrict in both proposals that PUCCH repetition can only occur on PCell if we really want to reduce the latency of PUCCH repetition? |
| LG | Support the proposal. Comparing to RAN1#110 mode, Alt. 2A has less issues and better resource availability, which is main purpose of PUCCH carrier switching.  |
| ZTE | @Samsung, CATT, FL. It seems we are in the deadlock among the soultions of 2A, 110meeting and 109 meeting.Can we take a simple way to solve the concern on each solution?Based on the proposal in #109, we can have a conclusion that: “For slots with PUCCH transmission(s) on PCell with repetition of >1 according to clause 9.2.6, the UE does not except to be indicated with a value of ‘1’ by the *pucch-sSCellPattern*.”. But the conclusion doesn’t need to be captured in the specification. We only need to capture UE follows the rule of Rel-15/16 for PUCCH repetition in the below TP.The changes in section 9.A mean that the base station cannot configure PUCCH resources with PUCCH repetitions in the SCell. The base station can easily achieve the above configuration after the frame structure is determined. The base station should configure PUCCH cell on the PCell to ensure UE can reuse of R15/16 rules. For example, if a PCell slot is a UL slot (or a slot containing flexible symbols), the PCell should be configured as PUCCH cell during the PCell slot. This can be implemented as a base station and there is no impact on the specification.If gNB can’t ensure the configuration, gNB can have the freedom to release the coupling between PUCCH repetition and PUCCH cell switching.**TP**:

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| 9.A PUCCH cell switchingThis clause is applicable when a UE is provided a PUCCH-sSCell by *pucch-sSCell* and the PUCCH-sSCell is activated and does not have a dormant UL/DL active BWP. A UE can be provided a periodic cell switching pattern for PUCCH transmissions by *pucch-sSCellPattern.* Each bit of the pattern corresponds to a slot for a reference SCS configuration provided by *tdd-UL-DL-ConfigurationCommon* for the PCell with a value of '0' or a value of '1' indicating, respectively, the PCell or the PUCCH-sSCell as the cell for PUCCH transmissions during the slot of the reference SCS configuration. The UE does not transmit a PUCCH in a slot on a cell if the pattern indicates a different cell for PUCCH transmission during the slot. A slot on the active UL BWP of the PUCCH-sSCell does not overlap with more than one slot on the active UL BWP of the PCell. If a slot for the active UL BWP of the PCell overlaps with more than one slot on the active BWP of the PUCCH-sSCell and the UE would transmit a PUCCH on the PUCCH-sSCell, the UE considers the first of the overlapping slots for the PUCCH transmission on the PUCCH-sSCell. If the UE is provided *PUCCH-sSCellPattern*, UE transmits a PUCCH over $N\_{PUCCH}^{repeat}>1$ slots according to 9.2.6. |

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| Moderator | @ZTEthanks for the proposal. To your paragraph in yellow: I guess we discussed this in Toulouse – that gNB guarantees the PCell is ‘configured’ for UL slots with the repetitions – and you just laid out nicely how the gNB could be guaranteeing that. **The issue:** Please note that Samsung also objected to that, as Samsung argument has been the gNB will not be able to guarantee this.What I didn’t fully get is your paragraph in magenta: What do you mean with’release the coupling’ – you mean gNB would not use / configure / apply the feature combination? |
| ZTE | @Moderator: Reply the yellow part: Yes, the release is NOT apply the feature combination.This thought is from proposal 1.1. Can we let the gNB to select the choice? I know in this stage, maybe no way for gNB to configure something new. Just a possible way. |
| Huawei, HiSilicon | For the case that PUCCH cannot be transmitted on PCell, which is very likely the typical case for PUCCH switching, indeed Alt. 2A here is better from latency perspective.  |
| LG | We are bit confused with ZTE’s TP. UE behavior in 9.2.6 based on the determined cell. Thus, UE needs to determine a cell first. Does it allow to transmit PUCCH repetition on PUCCH-sSCell? Even if we assumes that PCell is considered for 9.2.6, this way seems only works when gNB configure the pattern as ‘0’ for all UL slot for the PUCCH in a PCell. First of all, it is difficult to determine “UL slot” before the scheduling PUCCH, since valid UL slot are dependant to PUCCH resource in 9.2.6. And we cannot sure it is desirable to force to use PCell everytime even when there are empty resource for PUCCH in PUCCH-sSCell. If the TP is to work with another TP for Alt.2 A below. We are fine with the TP.  |
| ZTE | @LG, yes, your understanding is right especially for the UL slot for the PUCCH in PCell. In extreme case, gNB will make sure all the possible UL slots (maybe semi-static) in PCell to be configured by ‘0’ in the pattern. From PCell side, this is a kind of decoupling between PUCCH repetition and PUCCH cell switching. At least the PUCCH repetition transmission in PCell has no addition latency. The shortage is as LG said, the resource efficiency of PUCCH cell switching may not be fully used. While this approach doesn’t prevent the PUCCH transmisstion in the UL slots of Scell when the slots overlap with the DL slot in PCell, in these slot, the pattern can be configured as ‘1’. This is helpful for the usage of UL slot in Scell. If the TDD pattern of two cells are well configured, for example, total complementary frame structures between the PCell and Scell, the loss of resource usage can be reduced to a very low level. |
| Samsung | Regarding the suggestion by ZTE, it is not possible for the pattern to indicate all slots that have PUCCH repetitions to be on the PCell – it is then not possible to have pattern/switching even for no repetitions and all PUCCH transmissions will be on the PCell.Regarding Alt.2A, setting aside some technical aspects (e.g. not only using a pattern to reduce latency doesn’t do anything for PUCCH repetitions but it may actually increase latency!), a main issue is the following. RAN1 failed to agree on supporting PUCCH cell switching for repetitions even though that is when the feature would make most sense for a given UE and even though such support was most trivial to provide. That made the feature of PUCCH cell switching practically useless for a UE that could require PUCCH repetitions. Now, on top of that, Alt.2A wants to change the UE procedure for PUCCH repetitions due to the pattern, even though the pattern is irrelevant to a PUCCH transmission with repetitions – i.e. with Alt.2A, not only PUCCH repetitions get no benefit from a pattern, the procedure changes as well (and latency may also increase). It should be clear that makes no sense. |
| ZTE | @ Samsung. Actually not all PUCCH transmission will be on the PCell, as I said, if PCell and Scell have complementary frame structures, for example, PCell is DDDUU, and Scell is UUUDD. gNB ensure the pattern for the last two Us in PCell to be configured as ‘0’, and then the PUCCH repetition will anyway be transmitted in the last two Us in PCell. gNB can configure the patter for first three Ds in SCell as ‘1’, and then other PUCCH without repetition can be transmitted in the first three slots in Scell.  |

**RAN1#110 intention**

Here, I tried to remove some ‘details’ based on the Samsung objection here. What was kept is the ‘reference SCS granularity’ and to guarantee the ‘neglect’ the pattern is applicable for PUCCH with repetition as well as PUCCH without repetition (as this seems the bare minimum we need to guarantee):

**Mod Proposal 1.6.1 for email approval: PUCCH repetition for semi-static PUCCH switching is supported based on the following operation:**

* **~~the UE does not expect to be configured with any PUCCH resource with~~** $N\_{PUCCH}^{repeat}>1$ **~~on PUCCH-sSCell~~**
* **~~the UE does not expect to be indicated by the semi-static PUCCH cell pattern as sSCell on the slot of the 1~~~~st~~ ~~PUCCH repetition~~**
* **for UL slots of the reference SCS configuration starting from the slot where the UE would transmit a first repetition of a PUCCH ~~with the 2~~~~nd~~ ~~after the 1~~~~st~~ ~~PUCCH repetition~~ till the slot with the last PUCCH repetition:**
	+ **the UE always transmits the PUCCH repetition on PCell regardless of the indication of the semi-static PUCCH cell pattern**
	+ **the UE transmits scheduled/configured PUCCH without PUCCH repetition also on the PCell regardless of the indication of the semi-static PUCCH cell pattern, and the multiplexing in clause 9.2.5 and 9.2.6 in 38.213 happens after determining the PCell**

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| Support:  | ZTE |
| Object:  | Samsung |

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| *Company* | *Comments*  |
| ZTE | Support though some restrictions are removed. |
| Samsung | It is not understood why a TP for 38.213 is not presented for agreement – it is already available for the “RAN1#110 intention”. There is no other issue to discuss as operation for PUCCH transmission with repetitions would be as in Rel-16. The above has the risk to start (again) other discussions for (mis)interpretation. It would be preferable to conclude, in whatever way, everything now. If that is the “RAN1#110 intention”, there should be a TP for it.  |
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**RAN1#109 intention (as requested by ZTE):**

**Proposal Alt. 3 for email approval: Semi-static PUCCH cell switching and PUCCH repetition operation is supported based on the following TP:**

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| 9.A PUCCH cell switchingThis clause is applicable when a UE is provided a PUCCH-sSCell by *pucch-sSCell* and the PUCCH-sSCell is activated and does not have a dormant UL/DL active BWP. A UE can be provided a periodic cell switching pattern for PUCCH transmissions by *pucch-sSCellPattern.* Each bit of the pattern corresponds to a slot for a reference SCS configuration provided by *tdd-UL-DL-ConfigurationCommon* for the PCell with a value of '0' or a value of '1' indicating, respectively, the PCell or the PUCCH-sSCell as the cell for PUCCH transmissions during the slot of the reference SCS configuration. The UE does not transmit a PUCCH in a slot on a cell if the pattern indicates a different cell for PUCCH transmission during the slot. A slot on the active UL BWP of the PUCCH-sSCell does not overlap with more than one slot on the active UL BWP of the PCell. If a slot for the active UL BWP of the PCell overlaps with more than one slot on the active BWP of the PUCCH-sSCell and the UE would transmit a PUCCH on the PUCCH-sSCell, the UE considers the first of the overlapping slots for the PUCCH transmission on the PUCCH-sSCell. If the UE is provided *PUCCH-sSCellPattern*, UE transmits a PUCCH over $N\_{PUCCH}^{repeat}>1$ slots according to 9.2.6. |

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| Support:  | ZTE |
| Object:  |  |

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| *Company* | *Comments*  |
| ZTE | If we cannot achieve agreement on 2.A or the proposal in RAN1#110, this solution can be a candidate which is better other than the worse choice, i.e., disable the combination of two functions. |
| Samsung | Is the intention to say “If the UE would transmit a PUCCH over $N\_{PUCCH}^{repeat}>1$ slots, the *PUCCH-sSCellPattern* is not applicable and the UE transmits the PUCCH as described in clause 9.2.6.”? If so, we would support such TP. |
| ZTE | @Samsung, not this understanding, actually gNB to ensure the pattern set to 0 for the PUCCH slot in PCell, and then UE does not need to worry about to read the wrong pattern configuration and transmit the PUCCH repetition in the wrong Scell. This is the reason why UE transmits a PUCCH over $N\_{PUCCH}^{repeat}>1$ slots according to 9.2.6. |
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# Issue#2: Correction on RRC parameters for enhanced Type-3 codebook in TS 38.212 & 38.213

* 1. Companies’ inputs

vivo raised the following in their draft CRs in [R1-2208599](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208599.zip) for TS 38.212 and [R1-2208600](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208600.zip) for TS 38.213:

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| Align the following RRC parameter name with the RRC specification in TS38.331: * Rel-17 enhanced Type-3 HARQ-ACK codebook in Sec. 7.3.1.2.2 & 7.3.1.2.3 of TS 38.212
	+ *pdsch-HARQ-ACK-EnhType3List*  *pdsch-HARQ-ACK-EnhType3ToAddModList*
	+ *pdsch-HARQ-ACK-EnhType3SecondaryList*  *pdsch-HARQ-ACK-EnhType3SecondaryToAddModList*
* Rel-17 enhanced Type-3 HARQ-ACK codebook in Sec. 9.1.4 of TS 38.213
	+ *pdsch-HARQ-ACK-EnhType3List*  *pdsch-HARQ-ACK-EnhType3ToAddModList*
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With the following related draft CR to 38.212

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| \*\*\* Unchanged text omitted \*\*\*7.3.1.2.2 Format 1\_1\*\*\* Unchanged text omitted \*\*\*- One-shot HARQ-ACK request – 0 or 1 bit.- 1 bit if higher layer parameter *pdsch-HARQ-ACK-OneShotFeedback-r16* or *pdsch-HARQ-ACK-EnhType3ToAddModList* is configured;- 0 bit otherwise.If the UE is configured with a PUCCH-SCell, *pdsch-HARQ-ACK-EnhType3ToAddModList* is replaced by *pdsch-HARQ-ACK-EnhType3SecondaryToAddModList* for the secondary PUCCH group*.*- Enhanced Type 3 codebook indicator - 0, 1, 2, or 3 bits.- 0 bit if *pdsch-HARQ-ACK-EnhType3DCI-Field* is not configured;- $\left⌈log\_{2}(n\_{CB})\right⌉$ bits otherwise, where$n\_{CB}$ is the number of entries in the higher layer parameter *pdsch-HARQ-ACK-EnhType3ToAddModList.* If the UE is configured with a PUCCH-SCell, *pdsch-HARQ-ACK-EnhType3DCI-Field* is replaced by *pdsch-HARQ-ACK-EnhType3DCI-FieldSecondaryPUCCHgroup* for the secondary PUCCH group, and *pdsch-HARQ-ACK-EnhType3ToAddModList* is replaced by *pdsch-HARQ-ACK-EnhType3SecondaryToAddModList* for the secondary PUCCH group*.*\*\*\* Unchanged text omitted \*\*\*7.3.1.2.3 Format 1\_2\*\*\* Unchanged text omitted \*\*\*- Enhanced Type 3 codebook indicator - 0, 1, 2, or 3 bits. - 0 bit if *pdsch-HARQ-ACK-EnhType3DCI-Field-1-2*  is not configured; - $\left⌈log\_{2}(n\_{CB})\right⌉$ bits otherwise, where$n\_{CB}$ is the number of entries in the higher layer parameter *pdsch-HARQ-ACK-EnhType3ToAddModList.* If the UE is configured with a PUCCH-SCell, *pdsch-HARQ-ACK-EnhType3ToAddModList* is replaced by *pdsch-HARQ-ACK-EnhType3SecondaryToAddModList* for the secondary PUCCH group.\*\*\* Unchanged text omitted \*\*\* |

and draft CR to 38.213:

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| \*\*\* Unchanged text omitted \*\*\*9.1.4 Type-3 HARQ-ACK codebook determination If a UE is provided *pdsch-HARQ-ACK-OneShotFeedback*, the UE determines $\tilde{o}\_{0}^{ACK},\tilde{o}\_{1}^{ACK},…,\tilde{o}\_{O\_{ACK}-1}^{ACK}$ HARQ-ACK information bits, for a total number of $O\_{ACK}$ HARQ-ACK information bits, of a Type-3 HARQ-ACK codebook according to the following procedure. If the UE is provided *pdsch-HARQ-ACK-EnhType3ToAddModList* and a DCI format scheduling PDSCH reception and triggering the Type-3 HARQ-ACK codebook includes an enhanced Type 3 codebook indicator field that provides a value for *pdsch-HARQ-ACK-EnhType3Index*, the UE determines a size of a set of indicated serving cells $N\_{cells}^{DL,ind}$ and a size of a set of indicated numbers of HARQ processes $N\_{HARQ,c}^{DL,ind}$ for each indicated serving cell and each indicated HARQ process number from the entry in *pdsch-HARQ-ACK-EnhType3ToAddModList* corresponding to the *pdsch-HARQ-ACK-EnhType3Index* value. If the DCI format does not include the enhanced Type 3 codebook indicator field, the *pdsch-HARQ-ACK-EnhType3Index* value is zero.\*\*\* Unchanged text omitted \*\*\*If - a UE detects a DCI format that includes a One-shot HARQ-ACK request field with value 1, and- the CRC of the DCI is scrambled by a C-RNTI or an MCS-C-RNTI, and- *resourceAllocation* = *resourceAllocationType0* and all bits of the frequency domain resource assignment field in the DCI format are equal to 0, or- *resourceAllocation* = *resourceAllocationType1* and all bits of the frequency domain resource assignment field in the DCI format are equal to 1, or- *resourceAllocation = dynamicSwitch* and all bits of the frequency domain resource assignment field in the DCI format are equal to 0 or 1the DCI format provides a request for a Type-3 HARQ-ACK codebook report and does not schedule a PDSCH reception. If the UE is provided *pdsch-HARQ-ACK-EnhType3ToAddModList* and the DCI format includes an enhanced Type 3 codebook indicator field that provides a value for *pdsch-HARQ-ACK-EnhType3Index*, the UE determines a number of indicated serving cells $N\_{cells}^{DL,ind}$ and a number of indicated HARQ processes $N\_{HARQ,c}^{DL,ind}$ for each indicated serving cell $c$ from the entry in *pdsch-HARQ-ACK-EnhType3ToAddModList* corresponding to the *pdsch-HARQ-ACK-EnhType3Index* value. If the DCI format does not include the enhanced Type 3 codebook indicator field, the *pdsch-HARQ-ACK-EnhType3Index* value is provided by the value of MCS field in the DCI format. The UE is expected to provide HARQ-ACK information in response to the request for the Type-3 HARQ-ACK codebook after $N$ symbols from the last symbol of a PDCCH providing the DCI format, where the value of $N$ for $μ=0,1,2$ is provided in clause 10.2 by replacing "SPS PDSCH release" with "DCI format". If a UE multiplexes HARQ-ACK information in a PUSCH transmission, the UE generates the HARQ-ACK codebook as described in this clause except that *harq-ACK-SpatialBundlingPUCCH* is replaced by *harq-ACK-SpatialBundlingPUSCH*.\*\*\* Unchanged text omitted \*\*\* |

* 1. Initial (pre-meeting) moderator assessment & suggested handling during RAN1#110bis-e

**The identified RRC parameter corrctions by vivo seem valid and would need to be corrected.**

**Moderator suggested handling:**

* **Treat the issue during RAN1#110bis-e**
* Refer RRC parameter corrections to the editor alignment CRs of 38.212 and 38.213 - as we have done in RAN1#110, and as guided by Mr. chairman to moderators offline: “*Please make sure that* ***only technical*** *corrections are endorsed as individual Cat F CRs. For anything else, let’s use alignment CRs from the editors”*
	1. Issue to be handled during RAN1#110bis-e?

**Question: Do you support discussing Issue #2 during RAN1#110bis-e?**

|  |  |
| --- | --- |
| Yes - support:  | CATT OPPO, LG, Intel, Nokia/NSB, Samsung ,New H3C, vivo, Spreadtrum, ZTE, DOCOMO, Huawei, HiSilicon  |
| No - not support:  |  |

**Comments on the moderator comments / suggested handling or any other comments:**

|  |  |
| --- | --- |
| *Company* | *Comments*  |
| Samsung | Can be included in the alignment CRs |
| vivo | Agree with moderator’s suggestion on the handling “to the editor alignment CR” |
| Spreadtrum | It can be in the alignment CR. |
|  |  |
|  |  |

* 1. 1st round of email approval

There has been strong support for discussing this – and this to be included in the alignment CR.

Therefore, let’s check directly if we could agree this in the first round based on the following proposal:

**Proposal 2 for email approval:**

* **The identified RRC parameter corrections by vivo in** [**R1-2208599**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208599.zip) **are referred to the 38.212 editor alignment CR.**
* **The identified RRC parameter corrections by vivo in** [**R1-2208600**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208600.zip) **are referred to the 38.213 editor alignment CR.**

|  |  |
| --- | --- |
| Support:  | Nokia/NSB, Intel, vivo, CATT, Huawei/HiSilicon, New H3C, OPPO, ZTE, Samsung |
| Object:  |  |

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| --- | --- |
| *Company* | *Comments*  |
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# Issue#3: MCS field of the first TB used for enh. Type 3 CB indication and HARQ-ACK re-tx slot offset indication

* 1. Companies inputs

OPPO raised in two draft CRs, that when using the MCS field for indication, it would need to be clarified in 38.213 that for DCI format 1\_1, if the DCI has MCS fields for the transport block 1 & 2, the MCS field of transport block 1 should be used.

The draft CR on the enh. Type 3 CB by OPPO in [**R1-2208864**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208864.zip) reads as:

|  |
| --- |
| 9.1.4 Type-3 HARQ-ACK codebook determination \*\*\* Unchanged text is omitted \*\*\*If - a UE detects a DCI format that includes a One-shot HARQ-ACK request field with value 1, and- the CRC of the DCI is scrambled by a C-RNTI or an MCS-C-RNTI, and- *resourceAllocation* = *resourceAllocationType0* and all bits of the frequency domain resource assignment field in the DCI format are equal to 0, or- *resourceAllocation* = *resourceAllocationType1* and all bits of the frequency domain resource assignment field in the DCI format are equal to 1, or- *resourceAllocation = dynamicSwitch* and all bits of the frequency domain resource assignment field in the DCI format are equal to 0 or 1the DCI format provides a request for a Type-3 HARQ-ACK codebook report and does not schedule a PDSCH reception. If the UE is provided *pdsch-HARQ-ACK-EnhType3List* and the DCI format includes an enhanced Type 3 codebook indicator field that provides a value for *pdsch-HARQ-ACK-EnhType3Index*, the UE determines a number of indicated serving cells $N\_{cells}^{DL,ind}$ and a number of indicated HARQ processes $N\_{HARQ,c}^{DL,ind}$ for each indicated serving cell $c$ from the entry in *pdsch-HARQ-ACK-EnhType3List* corresponding to the *pdsch-HARQ-ACK-EnhType3Index* value. If the DCI format does not include the enhanced Type 3 codebook indicator field, the *pdsch-HARQ-ACK-EnhType3Index* value is provided by the value of MCS field in the DCI format. If there are two MCS fields for two transport blocks in the DCI format, the *pdsch-HARQ-ACK-EnhType3Index* value is provided by the value of MCS field for transport block 1 in the DCI format. The UE is expected to provide HARQ-ACK information in response to the request for the Type-3 HARQ-ACK codebook after $N$ symbols from the last symbol of a PDCCH providing the DCI format, where the value of $N$ for $μ=0,1,2$ is provided in clause 10.2 by replacing "SPS PDSCH release" with "DCI format". \*\*\* Unchanged text is omitted \*\*\* |

The draft CR by OPPO on the HARQ-ACK re-transmission in [**R1-2208865**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208865.zip) reads as:

|  |
| --- |
| 9.1.5 HARQ-ACK codebook retransmission\*\*\* Unchanged text is omitted \*\*\*If the HARQ-ACK retransmission indicator field value in the DCI format 1\_1 or 1\_2 is '1', the UE determines slot $m$ as $m=n-l$ where $l$ is determined by a one-to-one mapping in ascending order among the values of the MCS field for transport block 1 in the DCI format 1\_1 or the MCS field in the DCI format 1\_2 and the values from -7 to 24.\*\*\* Unchanged text is omitted \*\*\* |

* 1. Initial (pre-meeting) moderator assessment & suggested handling during RAN1#110bis-e

**The identified change by OPPO seem valid and would need to be corrected.**

**Moderator suggested handling:**

* **Treat the issue during RAN1#110**
* Have a joint discussion and a single CR with aligned wording on both, enh. Type 3 CB and HARQ-ACK retransmission.
	1. Issue to be handled during RAN1#110bis-e?

**Question: Do you support discussing Issue #3 during RAN1#110bis-e?**

|  |  |
| --- | --- |
| Yes - support:  | CATT OPPO, LG, Intel, Nokia/NSB, Samsung,New H3C, vivo, Spreadtrum, ZTE, DOCOMO, Huawei, HiSilicon |
| No - not support:  |  |

**Comments on the moderator comments / suggested handling or any other comments:**

|  |  |
| --- | --- |
| *Company* | *Comments*  |
| Samsung | The proposed TPs are OK. |
|  |  |
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* 1. 1st round of email approval

The moderator proposes the following text changes which in contrast to the OPPO formulation aligns the wording for both use cases here (apply the same proposed wording of OPPO for the HARQ-ACK re-tx also for the enh. Type 3 CB):

|  |
| --- |
| 9.1.4 Type-3 HARQ-ACK codebook determination \*\*\* Unchanged text is omitted \*\*\*If the DCI format does not include the enhanced Type 3 codebook indicator field, the *pdsch-HARQ-ACK-EnhType3Index* value is provided by the value of the MCS field for transport block 1 in the DCI format 1\_1 or the MCS field in the DCI format 1\_2. The UE is expected to provide HARQ-ACK information in response to the request for the Type-3 HARQ-ACK codebook after $N$ symbols from the last symbol of a PDCCH providing the DCI format, where the value of $N$ for $μ=0,1,2$ is provided in clause 10.2 by replacing "SPS PDSCH release" with "DCI format". \*\*\* Unchanged text is omitted \*\*\*9.1.5 HARQ-ACK codebook retransmission\*\*\* Unchanged text is omitted \*\*\*If the HARQ-ACK retransmission indicator field value in the DCI format 1\_1 or 1\_2 is '1', the UE determines slot $m$ as $m=n-l$ where $l$ is determined by a one-to-one mapping in ascending order among the values of the MCS field for transport block 1 in the DCI format 1\_1 or the MCS field in the DCI format 1\_2 and the values from -7 to 24.\*\*\* Unchanged text is omitted \*\*\* |

**Question 3.1: Do you support the TP above? If you have any comments on the wording, please provide your comments in the table below.**

|  |  |
| --- | --- |
| Support:  | Nokia/NSB, Intel, CATT, Huawei/HiSilicon, New H3C, OPPO, ZTE, Samsung |
| Object:  |  |

|  |  |
| --- | --- |
| *Company* | *Comments*  |
| OPPO | We appreciate for the concise TP from moderator and we are generally fine with the direction of the TP. However, for eType-3 CB, we have a little concern about the wording (not technically). This is because at the beginning of paragraph of eType-3 CB, it says “If the DCI format…” but the later change directly describes “DCI format 1\_1 or DCI format 1\_2”, this gives the impression of “the DCI format” at the begaining and the “DCI format 1\_1 or DCI format 1\_2” afterwards may be not a same DCI format which seems a little ambiguity. The issue does not exist for HARQ-ACK CB re-tx since it says “DCI format 1\_1 or DCI format 1\_2” at the start the its corresponding paragraph.If majority companies suppose that there is no such ambiguity, we can also accept the TP😊 |
| Moderator | @OPPO: I guess this DCI format you highlight should not really create any issue to my reading there. It should be rather clear – at least to me, and the nice thing that we have the formulations aligned… (not using different wording in different places for exactly the same thing).  |
|  |  |
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**The moderator provided a draft CR based on the TP above in the drafts folder here (please check for Issue#3):** [**8.3(NR\_IIOT\_URLLC\_enh)/HARQ\_enh/Draft CRs (3gpp.org)**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Inbox/drafts/8.3%28NR_IIOT_URLLC_enh%29/HARQ_enh/Draft%20CRs)

* 1. 2nd round of email approval

It seems that plenty of companies were fine with the TP, so let’s see if we can then also agree the related draft CR provided by moderator.

**If no objection received by the end of the 2nd email approval round, we consider the draft CR agreed (Klaus will try to get Tdoc number in the mean-while, und replace the word draft CR with the TDoc number at the end of the 2nd round based on the version in the drafts folder).**

**Proposal 3 for email approval: Adopt the draft CR in [R1-2210530](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Inbox/R1-2210530.zip) on Issue #3 to 38.213.**

|  |  |
| --- | --- |
| Support:  | Nokia/NSB, vivo, Samsung, CATT, New H3C, Intel , ZTE, Huawei, HiSilicon |
| Object:  |  |

|  |  |
| --- | --- |
| *Company* | *Comments*  |
| Samsung | A suggestion is to combine agreed CRs into a single CR (as in some other WIs in RAN1#110). It is always better to have a single reference document for changes from one meeting and the current framework for Rel-17 CRs makes that possible. |
| ModeratorContinuation in 2nd round | @Samsung: I thought that we still continue to have one CR per issue (and this is to combine at least 2 input draft CRs to one already). We should clearly not push the boundaries to have too many CRs, but personally would be happy to have some of the things resolved (from the table) than having the wording discussions then in the end on e.g. header etc. when trying to combine multiple of them in a single CR. But willing to hear other companies comments here of course on this issue.  |
| Vivo | For the drafted CRs approved by the Chair at the same time, maybe it can have a single CR to combine all the changes.  |
| Samsung | Regarding the CRs, it is just a suggestion. It is nicer/easier to have a single CR, particularly when the individual CRs are relatively simple, as everything is put together. No issue if the moderator prefers otherwise. |
|  |  |
|  |  |

# Issue#4: Clarification on overlapping PUCCH for SPS HARQ-ACK deferral

* 1. Companies’ inputs

Samsung in [**R1-2209699**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209699.zip) discusses has the following arguments for a need for change to the SPS HARQ-ACK deferral description:

|  |
| --- |
| Reason: The current spec is not clear if the result PUCCH is provided by *sps-PUCCH-AN-List or* *n1PUCCH-AN* and overlaps with semi-static DL symbols in a second slot.Change: Clarify that UE defers the SPS HARQ-ACK in a next slot if the result PUCCH is provided by *sps-PUCCH-AN-List or n1PUCCH-AN* and overlaps with semi-static DL symbols in a second slotIf not approved: Unclear UE behaviour for SPS HARQ-ACK deferral if the result PUCCH is provided by *sps-PUCCH-AN-List or n1PUCCH-AN* and overlaps with semi-static DL symbols in a second slot. |

.. with the following change to TS 38.213 (omitted text by Samsung amended by moderator for easier checking for delegates to have the full picture available):

|  |
| --- |
| 9.2.5.4 UE procedure for deferring HARQ-ACK for SPS PDSCH \*\*\* Unchanged text is omitted \*\*\*If a UE is provided *sps-HARQ-Deferral* and, after performing the procedures in clauses 9 and 9.2.5 to resolve overlapping among PUCCHs and PUSCHs in a first slot, if any, the UE determines a PUCCH resource for a PUCCH transmission with first HARQ-ACK information bits for SPS PDSCH receptions that the UE would report for a first time, and the PUCCH resource- is provided by *SPS-PUCCH-AN-List* as described in clause 9.2.1, or by *n1PUCCH-AN* if *SPS-PUCCH-AN-List* is not provided- is not cancelled by an overlapping PUCCH or PUSCH transmission of larger priority index- overlaps with a symbol indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigDedicated*, or indicated for a SS/PBCH block by *ssb-PositionsInBurst*, or belonging to a CORESET associated with a Type0-PDCCH CSS set the UE - determines an earliest second slot and, after performing the procedures in clauses 9.2.1 and 9.2.3 to determine a PUCCH with HARQ-ACK information bits including second HARQ-ACK information bits and then performing the procedures in clauses 9 and 9.2.5 to resolve overlapping among PUCCHs and PUSCHs, if any, a PUSCH or a PUCCH in the earliest second slot to multiplex HARQ-ACK information bits that include second HARQ-ACK information bits from the first HARQ-ACK information bits , where the second HARQ-ACK information bits correspond to SPS PDSCH configurations with *sps-HARQ-Deferral* values that are larger than or equal to a time difference, with reference to slots for PUCCH transmissions on the primary cell, between the second slot and the slot of the SPS PDSCH reception, if any- if the UE detects a DCI format in a PDCCH reception that triggers a PUCCH transmission with a Type-3 HARQ-ACK codebook in a slot as described in clause 9.1.4, the UE stops the procedure to determine the earliest second slot in the slot- if the UE is provided a periodic cell switching pattern for PUCCH transmissions by *pucch-sSCellPattern*, the UE determines the earliest second slot and a corresponding cell based on the periodic cell switching pattern as described in clause 9.A- if the UE multiplexes the second HARQ-ACK information in a PUSCH, or in a PUCCH using a resource that is not from *SPS-PUCCH-AN-List*, or from *n1PUCCH-AN* if *SPS-PUCCH-AN-List* is not provided, the UE stops the procedure to determine the earliest second slot in the slot- if the UE multiplexes the second HARQ-ACK information in a first PUCCH using a resource provided by *SPS-PUCCH-AN-List*, or by *n1PUCCH-AN* if *SPS-PUCCH-AN-List* is not provided, of smaller priority index and the UE drops the first PUCCH transmission due to an overlapping with a second PUSCH or PUCCH transmission of larger priority index, the UE stops the procedure to determine the earliest second slot in the slot- if the UE multiplexes the second HARQ-ACK information in a first PUCCH using a resource provided by *SPS-PUCCH-AN-List*, or by *n1PUCCH-AN* if *SPS-PUCCH-AN-List* is not provided, and the PUCCH transmission is not dropped due to an overlapping with a PUSCH or PUCCH transmission of larger priority ~~and~~* if the first PUCCH does not have any symbol that overlaps with a symbol indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigDedicated*, or indicated for a SS/PBCH block by *ssb-PositionsInBurst*, or belonging to a CORESET associated with a Type0-PDCCH CSS set, the UE stops the procedure to determine the earliest second slot in the slot
* otherwise, the UE defers the first HARQ-ACK information bits to a next slot

- the second HARQ-ACK information bits, generated as described in clause 9.1.2, are appended in a HARQ-ACK codebook the UE generates as described in clauses 9.1.2, 9.1.2.1, 9.1.3.1, or 9.1.5- if the UE would receive a PDSCH providing a TB for a same HARQ process as a HARQ-ACK information bit from the second HARQ-ACK information bits prior to transmitting the PUCCH or the PUSCH, the UE does not include the HARQ-ACK information bit in the HARQ-ACK information bits.The UE does not expect to be provided both *sps-HARQ-Deferral* and *nrofSlots* or *pucch-RepetitionNrofSlots* for any PUCCH resource of same priority.\*\*\* Unchanged text is omitted \*\*\* |

* 1. Initial (pre-meeting) moderator assessment & suggested handling during RAN1#110bis-e

**(Initial) Moderator assessment:**

* The Samsung suggested clarification adds the condition the UE actually continues the deferral to a next earliest 2nd slot – as currently, the 5 ‘if-statements’ only describe when the UE actually stops looking for a earliest 2nd slot.

**Moderator suggested handling:**

* **Treat the issue during RAN1#110bis-e**
	1. Issue to be handled during RAN1#110bis-e?

**Question: Do you support discussing Issue #4 during RAN1#110bis-e?**

|  |  |
| --- | --- |
| Yes - support:  | CATT, Samsung, vivo, Spreadtrum |
| No - not support:  | OPPO, LG |

**Comments on the moderator comments / suggested handling or any other comments on the draft CR:**

|  |  |
| --- | --- |
| *Company* | *Comments*  |
| CATT | We do not see a strong need for a CR but we are fine to discuss the issue and hear more views. |
| OPPO | Based on current spec., unless the stopping condition(s) are satisfied, it is to be understood UE would continue determining an earlist second slot which needs to satisfiy all the conditions. So the change is common understanding and seems not necessary. |
| LG | Based on the current framework, it seems common understanding that UE keep trying to determine earliest second slot unless UE procedure is stopped or leaching to sps-HARQ-Deferral. Once it is stopped, and if UE multiplexes second HARQ-ACK in a PUCCH as described, and if the PUCCH is not dropped, UE would transmit PUCCH with deferred HARQ-ACK codebook. Otherwise, UE wouldn’t transmit PUCCH since there is no possible case. We think the spec seems to work and further changes is not necessary.  |
| Intel  | We share similar view with OPPO an LG that CR is not necessary, but we can be fine for further discussion.  |
| Nokia/NSB | We don’t oppose discussing this – but maybe there is no ultimate need for this.  |
| Samsung | At the “top level” sub-bullet, there is the statement “the UE determines an earliest second slot …”. However, in the “lower level” sub-bullet, we think it is currently unclear that if the condition for “the UE stops the procedure to determine the earliest second slot in the slot” is not satisfied, the UE continues the deferral.The intention is to make clearer the UE procedure. If RAN1 thinks it is already clear, we’re fine to not further discuss the proposal.  |
| ZTE | Agree OPPO and LG, it seems the CR is not necessary.  |
| Huawei, HiSilicon | We don't think it is necessary but fine to disucss to conclude.  |

* 1. 1st round of email approval

Some companies not sure if a change is needed, but willing to discuss. So let’s continue the discussions here.

As there had not been any comments so far on the wording of the draft CR, let’s see if it would be possible to agree the draft CR with the following changes (on top of Samsung original CR):

* Sourcing company changed to 🡪 Moderator (Nokia), Samsung
* Minor changes to the header by moderator (with track changes on top of Samsung)
* Draft CR text by Samsung taken directly (no changes proposed)

**The moderator provided a draft CR based on the TP above in the drafts folder here (please check for Issue#4):** [**8.3(NR\_IIOT\_URLLC\_enh)/HARQ\_enh/Draft CRs (3gpp.org)**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Inbox/drafts/8.3%28NR_IIOT_URLLC_enh%29/HARQ_enh/Draft%20CRs)

Companies are encouraged to check the draft CR (incl. the header) – maybe we are able to agree the draft CR (v000) at the same time here.

**Proposal 4 for email approval: Adopt the draft CR in the** [**Draft CRs folder**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Inbox/drafts/8.3%28NR_IIOT_URLLC_enh%29/HARQ_enh/Draft%20CRs) **on Issue #4 to 38.213 on SPS deferral.**

|  |  |
| --- | --- |
| Support:  | Samsung |
| Object:  |  |

|  |  |
| --- | --- |
| *Company* | *Comments*  |
| Intel  | We think the CR is unnecessary, but we can accept the CR if it is majority view.  |
| vivo | From our perspective, the CR is not necessary. The main bullet describes “The UE determines an earliest second slot…” and several sub-bullets describes different conditions to stop the deferral procedure. In our opinion the logic is clear.  |
| CATT | We also think the CR is not needed. |
| Huawei, HiSilicon | We also think the CR is unnecessary with similar reason as vivo.  |
| New H3C | We also think this CR isn’t necessary. |
| OPPO | We also think the CR is not needed. |
| ZTE | We also think the CR is not needed. |
| Samsung | The intention is to remove possible ambiguity in the specifications. We think the CR is beneficial but OK if companies think there is no possibility of ambiguity (then, hopefully no such CR/discussion 1-2 years from now). |

* 1. 2nd round of email approval

Looking at the input given, it seems that the draft CR did not really receive a lot of support but majority of companies thinking the CR would not be needed. Therefore, it is suggested if we can just conclude to not adopt the CR (and mark it in red, as guided by Mr. chairman). If no objection received, we will take this as outcome / conclusion:

**Proposed conclusion for email approval: There is no consensus to adopt the changes in** [**R1-2209699**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209699.zip)**.**

|  |  |
| --- | --- |
| Support:  | CATT, New H3C, Intel, vivo, ZTE, Nokia, LG, Huawei, HiSilicon |
| Object:  |  |

|  |  |
| --- | --- |
| *Company* | *Comments*  |
| Samsung | OK |
|  |  |
|  |  |

# Issue#5: k1 / PDSCH-to-HARQ for semi-static PUCCH cell switching

* 1. Companies’ inputs

Nokia in [**R1-2210145**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210145.zip) provided a draft CR, based on the following reasoning:

|  |  |
| --- | --- |
| **Reason for change:** The current specifications do not clearly define on how to apply the PDSCH-to-HARQ slot offset for semi-static and dynamic PUCCH cell switching. For semi-static PUCCH cell switching, the slot offset is to be applied on PCell and not the cell for PUCCH transmission, whereas for dynamic PUCCH cell switching and no PUCCH switching, the slot offset is to be applied on the cell for PUCCH transmission. The following earlier RAN1 agreements are available:

|  |
| --- |
| **Agreement from RAN1#106bis-e**For semi-static PUCCH cell switching, PCell / PSCell / PUCCH-SCell is reference cell:* The time domain pattern configurations are based on the numerology of the reference cell.
* The PDSCH to HARQ-ACK offset k1 is interpreted based on the numerology and PUCCH configuration of a reference cell to be able to apply the time-domain PUCCH cell switching pattern.
* Note: There may not be a need to define a ‘reference cell’ in the specification. This terminology is used for further clarifications of the procedure.

**Agreement from RAN1#105-e:** For PUCCH carrier switching based on dynamic indication in DCI scheduling a PUCCH (i.e. Alt. 1), the PDSCH to HARQ-ACK offset k1 is interpreted based on the numerology of the dynamically indicated target PUCCH cell. |

**Change:** Correct the applicable PDSCH-to-HARQ slot offset for semi-static PUCCH cell switching. **If not approved:** Incorrect timing for HARQ-ACK reporting based on PDSCH-to-HARQ slot offset on PUCCH-sSCell for semi-static PUCCH cell switching. |

The draft CR looks as follows:

|  |
| --- |
| 9.2.3 UE procedure for reporting HARQ-ACK**< Unchanged parts are omitted >**If the UE is provided *subslotLengthForPUCCH*, $n$ is the last UL slot of the PCell if the UE is provided *pucch-sSCellPattern*, or the last UL slot of the serving cell for PUCCH transmission if the UE is not provided *pucch-sSCellPattern,* that overlaps with a PDSCH reception or with a PDCCH reception providing a DCI format having associated HARQ-ACK information without scheduling a PDSCH reception; otherwise, $n$ is the last UL slot of the PCell if the UE is provided *pucch-sSCellPattern*, or the last UL slot of the serving cell for PUCCH transmission if the UE is not provided *pucch-sSCellPattern,* that overlaps with the DL slot $n\_{D}$ for the PDSCH reception or with the DL slot $n\_{D} $for the PDCCH reception in case of a DCI format that triggers a HARQ-ACK information report and does not schedule a PDSCH reception.For a SPS PDSCH reception ending in DL slot $n\_{D}$, the UE transmits the PUCCH in UL slot $n+k$ of the PCell where $k$ is provided by the PDSCH-to-HARQ\_feedback timing indicator field, if present, in a DCI format activating the SPS PDSCH reception. If the UE detects a DCI format that does not include a PDSCH-to-HARQ\_feedback timing indicator field and schedules a PDSCH reception or activates a SPS PDSCH reception ending in DL slot $n\_{D}$, the UE provides corresponding HARQ-ACK information in a PUCCH transmission within UL slot $n+k$ of the PCell if the UE is provided *pucch-sSCellPattern*, or UL slot $n+k$ of the serving cell for PUCCH transmission if the UE is not provided *pucch-sSCellPattern,* where $k$ is provided by *dl-DataToUL-ACK*, or *dl-DataToUL-ACK-r16*, or *dl-DataToUL-ACK-DCI-1-2*, or *dl-DataToUL-ACK-r17*, or *dl-DataToUL-ACK-DCI-1-2-r17*, or *dl-DataToUL-ACK-MulticastDciFormat4\_1*.If the UE detects a DCI format scheduling a number of PDSCH receptions ending in DL slot $n\_{D}$ or if the UE detects a DCI format generating a HARQ-ACK information bit and does not schedule a PDSCH reception through a PDCCH reception ending in DL slot $n\_{D}$, the UE provides corresponding HARQ-ACK information in a PUCCH transmission within UL slot $n+k$ of the PCell if the UE is provided *pucch-sSCellPattern*, or UL slot $n+k$ of the serving cell for PUCCH transmission if the UE is not provided *pucch-sSCellPattern*, where $k$ is a number of slots and is indicated by the PDSCH-to-HARQ\_feedback timing indicator field in the DCI format, if present, or provided by *dl-DataToUL-ACK*, *dl-DataToUL-ACK-r16*, or *dl-DataToUL-ACK-DCI-1-2*, or *dl-DataToUL-ACK-r17*, or *dl-DataToUL-ACK-DCI-1-2-r17*, or *dl-DataToUL-ACK-MulticastDciFormat4\_1*. **< Unchanged parts are omitted >** |

* 1. Initial (pre-meeting) moderator assessment & suggested handling during RAN1#110bis

**The identified change by Nokia seem valid and would need to be corrected.**

**Moderator suggested handling:**

* **Treat the issue during RAN1#110bis-e**
	1. Issue to be handled during RAN1#110bis-e?

**Question: Do you support discussing Issue #5 during RAN1#110bis-e?**

|  |  |
| --- | --- |
| Yes - support:  | CATT OPPO, LG, Intel, Nokia/NSB, Samsung, New H3C, vivo, Spreadtrum, DOCOMO, Huawei, HiSilicon |
| No - not support:  |  |

**Comments on the moderator comments / suggested handling or any other comments:**

|  |  |
| --- | --- |
| *Company* | *Comments*  |
| CATT | We do not see a strong need for a CR but we are fine to discuss the issue and hear more views. |
| LG | We are fine to discuss |
| ZTE | We think the current specification is clear in the description in clause 9.2.3 in 38.213. Here the ‘otherwise’ means the case of semi-static PUCCH cell switch.“ If the DCI format indicates a cell for the PUCCH transmission, as described in clause 9.A, the **PDSCH-to-HARQ\_feedback timing indicator** field value **maps to slots of the active UL BWP of the cell**; **otherwise**, the PDSCH-to-HARQ\_feedback timing indicator field value **maps to slots of the active UL BWP of the PCell**.”But we will not object the discussion to further clarify.  |
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* 1. 1st and 2nd round of email approval

Strong majority of companies suggest discussing this – ZTE noted that some clarification is already available in Sec. 9.2.3, but are fine to continue discussing as well.

As there had been no comments on the text of the draft CR, let’s see if there are any comments on the draft CR by Nokia directly based on the following changes as provided in the drafts folder here:

* Sourcing company changed to Moderator (Nokia), Nokia, Nokia Shanghai Bell
* No other changes proposed
* Moderator comment still on the change / clarification for SPS: As also for dynamic indication of PUCCH cell switching the SPS HARQ-ACK is always on the PCell, the HARQ-ACK timing is determined by the PCell for all 3 cases: i.e. semi-static PUCCH cell switching, dynamic PUCCH cell switching and ‘no’ PUCCH cell switching

**The moderator provided a draft CR based on the TP above in the drafts folder here (please check for Issue#5):** [**8.3(NR\_IIOT\_URLLC\_enh)/HARQ\_enh/Draft CRs (3gpp.org)**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Inbox/drafts/8.3%28NR_IIOT_URLLC_enh%29/HARQ_enh/Draft%20CRs)

Companies are encouraged to check the draft CR (incl. the header) – maybe we are able to agree the draft CR (v000) at the same time here.

**Proposal 5 for email approval: Adopt the draft CR in the** [**Draft CRs folder**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Inbox/drafts/8.3%28NR_IIOT_URLLC_enh%29/HARQ_enh/Draft%20CRs) **on Issue #5 to 38.213 on SPS deferral.**

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| Support:  | Nokia/NSB, Intel, CATT, Huawei/HiSilicon, QC (Support in general. But think modification of CR is needed), New H3C, OPPO |
| Object:  | Samsung |

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| *Company* | *Comments*  |
| Vivo | We think the CR may not be necessary given following specifications in 213:9.A PUCCH cell switchingIf a UE is provided *pucch-sSCellDyn* or *pucch-sSCellDynDCI-1-2*, a corresponding DCI format associated with generation of HARQ-ACK information by the UE can include a PUCCH cell indicator field [5, TS 38.212] with a value of '0' or a value of '1' indicating, respectively, whether a PUCCH transmission with the HARQ-ACK information by the UE is on the PCell or on the PUCCH-sSCell. When the UE transmits a PUCCH with HARQ-ACK information that is associated only with SPS PDSCH receptions, the UE transmits the PUCCH on the PCell.[…]9.2.3 UE procedure for reporting HARQ-ACKIf the DCI format indicates a cell for the PUCCH transmission, as described in clause 9.A, the PDSCH-to-HARQ\_feedback timing indicator field value maps to slots of the active UL BWP of the cell; otherwise, the PDSCH-to-HARQ\_feedback timing indicator field value maps to slots of the active UL BWP of the PCell.[…] |
| QC | In general, the CR looks good to us, except there is a caveat. With PUCCH cell switch, UE can be configured with subslotLengthForPUCCH on Pcell, while configured with slotLengthFor PUCCH on Scell, or vise versa. Therefore, the meaning of “If the UE is provided subslotLengthForPUCCH” is not clear. A more precise way to fix the issue might be: if pucch-sSCellPattern is provided, UE follows subslot/slot configuration on PCell, if pucch-sSCellPattern is not provided, UE follows the subslot/slot configuation of the serving cell transmit the PUCCH.  |
| ZTE | Share the view with vivo. We will not object this CR, if majority thinks it can make specification more clear. |
| Samsung | Agree with Vivo – apparently, we did not check if the intention of the CR was already covered. Based on the observation by Vivo, there is no need (it is actually detrimental) to duplicate specifications. That also avoids other discussion (e.g. comment by QC). |
| Moderator2nd round start | @QC: I guess you meant that it is not clear for which PUCCH config (PCell or PUCCH-sSCell) this applies – when the latter part of the sentence is executed. I don’t see a bit problem with this, as also based on the current formulation it may not be really clear….@Samsung / vivo: point taken But let’s continue the discussion here & hear some more views as there had been rather good support for this.  |
| QC | @FL and all, to clarify what I meant in the first round. Current spec says “If the UE is provided subslotLengthForPUCCH”, UE does A; other wise, UE does B. Without PUCCH cell switch, this specification is clear, because UE always check whether subslotLengthForPUCCH is provided on Pcell then do A or B accordingly. But with Cell switch, UE does not know it should go to which cell to check whether subslotLengthForPUCCH is provided on that cell. Apparenlty, for semi-static switch, UE should check whether subslotLengthForPUCCH is provided on Pcell then decide to do A or B. But for dynamic switch, UE should check whether subslotLengthForPUCCH is provided on the serving cell that PUCCH is transmitted, then decide to do A or B.The above issue is related to issue #5. But not exactly the same as issue #5. I feel that even if we eventually decide not fix issue #5. The above issue might still need be fixed.  |
| Moderator | Thanks for the clarification by QC – let’s hear some other views here on the issue that QC identified in addition to Issue#5 on this part.  |
| Moderator | @QC: Sorry, took some time – but think I now finally got the point. So even without the proposed changes by Nokia otherwise it is currently not clear which cell is taken here when checking if subslot is configured. How about the following change to that paragraph (in green) – that would be then independent of the other changes there (in red):

|  |
| --- |
| 9.2.3 UE procedure for reporting HARQ-ACK**< Unchanged parts are omitted >**The following applies to PCell, if the UE is provided *pucch-sSCellPattern*, or the serving cell for PUCCH transmission otherwise: If the UE is provided *subslotLengthForPUCCH*, $n$ is the last UL slot for PUCCH transmission that overlaps with a PDSCH reception or with a PDCCH reception providing a DCI format having associated HARQ-ACK information without scheduling a PDSCH reception; otherwise, $n$ is the last UL slot for PUCCH transmission that overlaps with the DL slot $n\_{D}$ for the PDSCH reception or with the DL slot $n\_{D} $for the PDCCH reception in case of a DCI format that triggers a HARQ-ACK information report and does not schedule a PDSCH reception.For a SPS PDSCH reception ending in DL slot $n\_{D}$, the UE transmits the PUCCH in UL slot $n+k$ of the PCell where $k$ is provided by the PDSCH-to-HARQ\_feedback timing indicator field, if present, in a DCI format activating the SPS PDSCH reception. If the UE detects a DCI format that does not include a PDSCH-to-HARQ\_feedback timing indicator field and schedules a PDSCH reception or activates a SPS PDSCH reception ending in DL slot $n\_{D}$, the UE provides corresponding HARQ-ACK information in a PUCCH transmission within UL slot $n+k$ of the PCell if the UE is provided *pucch-sSCellPattern*, or UL slot $n+k$ of the serving cell for PUCCH transmission if the UE is not provided *pucch-sSCellPattern,* where $k$ is provided by *dl-DataToUL-ACK*, or *dl-DataToUL-ACK-r16*, or *dl-DataToUL-ACK-DCI-1-2*, or *dl-DataToUL-ACK-r17*, or *dl-DataToUL-ACK-DCI-1-2-r17*, or *dl-DataToUL-ACK-MulticastDciFormat4\_1*.If the UE detects a DCI format scheduling a number of PDSCH receptions ending in DL slot $n\_{D}$ or if the UE detects a DCI format generating a HARQ-ACK information bit and does not schedule a PDSCH reception through a PDCCH reception ending in DL slot $n\_{D}$, the UE provides corresponding HARQ-ACK information in a PUCCH transmission within UL slot $n+k$ of the PCell if the UE is provided *pucch-sSCellPattern*, or UL slot $n+k$ of the serving cell for PUCCH transmission if the UE is not provided *pucch-sSCellPattern*, where $k$ is a number of slots and is indicated by the PDSCH-to-HARQ\_feedback timing indicator field in the DCI format, if present, or provided by *dl-DataToUL-ACK*, *dl-DataToUL-ACK-r16*, or *dl-DataToUL-ACK-DCI-1-2*, or *dl-DataToUL-ACK-r17*, or *dl-DataToUL-ACK-DCI-1-2-r17*, or *dl-DataToUL-ACK-MulticastDciFormat4\_1*. **< Unchanged parts are omitted >** |

Could this address both issues for this paragraph – the initial intention by Nokia as well as the additional issue raised by QC? |
| LG | In our view, current CR is not needed since it is already covered by current specification as vivo mentioned. Based on QC’s comment, we see the problem at the sentence of “If the UE is provided *subslotLengthForPUCCH*,”. Both the CR and the current spec doesn’t describe which cell need to be checked for *subslotLengthForPUCCH.* It may be an issue as Qualcomm mentioned. Regarding updated TP, we think only green part is necessary. By the green part and existing spec, all red text can be removed. If someone has a concern on a readability, it would be fine to add “of the PCell” for SPS HARQ-ACK part.  |

* 1. 3rd round of email discussions

During the discussions in the first two rounds, QC raised one additional issue – namely, for which cell the subslot config should be applied. Moderator tried to clarify this in an updated TP – and maybe worth checking now the support / need for the different parts of the TP (as suggested by LG).

So let’s check the the issues separately:

* The yellow marked parts for the slot n definition: trying to address the QC concern (in addition to the Nokia raised issue#5) which could solve both concerns in
* The blue marked parts tying to clarify the SPS handling
* The green marked parts: trying to clarify the slot n+k definition, as raised by Nokia in their draft CR

based on the following TP:

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| 9.2.3 UE procedure for reporting HARQ-ACK**< Unchanged parts are omitted >**The following applies to PCell, if the UE is provided *pucch-sSCellPattern*, or the serving cell for PUCCH transmission otherwise: If the UE is provided *subslotLengthForPUCCH*, $n$ is the last UL slot for PUCCH transmission that overlaps with a PDSCH reception or with a PDCCH reception providing a DCI format having associated HARQ-ACK information without scheduling a PDSCH reception; otherwise, $n$ is the last UL slot for PUCCH transmission that overlaps with the DL slot $n\_{D}$ for the PDSCH reception or with the DL slot $n\_{D} $for the PDCCH reception in case of a DCI format that triggers a HARQ-ACK information report and does not schedule a PDSCH reception.For a SPS PDSCH reception ending in DL slot $n\_{D}$, the UE transmits the PUCCH in UL slot $n+k$ of the PCell where $k$ is provided by the PDSCH-to-HARQ\_feedback timing indicator field, if present, in a DCI format activating the SPS PDSCH reception. If the UE detects a DCI format that does not include a PDSCH-to-HARQ\_feedback timing indicator field and schedules a PDSCH reception or activates a SPS PDSCH reception ending in DL slot $n\_{D}$, the UE provides corresponding HARQ-ACK information in a PUCCH transmission within UL slot $n+k$ of the PCell if the UE is provided *pucch-sSCellPattern*, or UL slot $n+k$ of the serving cell for PUCCH transmission if the UE is not provided *pucch-sSCellPattern,* where $k$ is provided by *dl-DataToUL-ACK*, or *dl-DataToUL-ACK-r16*, or *dl-DataToUL-ACK-DCI-1-2*, or *dl-DataToUL-ACK-r17*, or *dl-DataToUL-ACK-DCI-1-2-r17*, or *dl-DataToUL-ACK-MulticastDciFormat4\_1*.If the UE detects a DCI format scheduling a number of PDSCH receptions ending in DL slot $n\_{D}$ or if the UE detects a DCI format generating a HARQ-ACK information bit and does not schedule a PDSCH reception through a PDCCH reception ending in DL slot $n\_{D}$, the UE provides corresponding HARQ-ACK information in a PUCCH transmission within UL slot $n+k$ of the PCell if the UE is provided *pucch-sSCellPattern*, or UL slot $n+k$ of the serving cell for PUCCH transmission if the UE is not provided *pucch-sSCellPattern*, where $k$ is a number of slots and is indicated by the PDSCH-to-HARQ\_feedback timing indicator field in the DCI format, if present, or provided by *dl-DataToUL-ACK*, *dl-DataToUL-ACK-r16*, or *dl-DataToUL-ACK-DCI-1-2*, or *dl-DataToUL-ACK-r17*, or *dl-DataToUL-ACK-DCI-1-2-r17*, or *dl-DataToUL-ACK-MulticastDciFormat4\_1*. **< Unchanged parts are omitted >** |

**Question 5.5: Which of the following components of the TP above do you see a need for / support?**

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| **Yellow part:QC issues raised in round 1 / 2 for slot n** | Support:  |  |
| Object:  | Samsung |
| **blue part:SPS clarification – PCell only** | Support:  |  |
| Object:  | Samsung |
| **Green part:Clarifiction for slot n +**  | Support:  |  |
| Object:  | Samsung |

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| *Company* | *Comments*  |
| ZTE | Frankly, the three colors part may be redundant descriptions. But I will not object them. |
| Samsung | All suggested changes are captured by the existing text that was cited by Vivo. Not only is the proposed change non-essential, it would actually be detrimental to make.  |
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# Issue#6: Timeline of determining SPS HARQ-ACK deferral

* 1. Companies’ inputs

Samsung in [**R1-2209700**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209700.zip) discusses the following (no draft CR provided):

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| For UCI multiplexing in a PUCCH or PUSCH, the UCI multiplexing timeline is ensured by gNB. For a deferred SPS HARQ-ACK multiplexing in a PUCCH or PUSCH in a target slot, the multiplexing timeline should also be satisfied. For an activated SPS PDSCH, a PUCCH with the SPS HARQ-ACK only can be determined semi-statically and whether the PUCCH with the SPS HARQ-ACK only collides with semi-static DL symbols can be determined semi-statically as well. If there is no overlapping PUCCH or PUSCH, the timeline for multiplexing the deferred SPS HARQ-ACK in the target slot can always be satisfied. However, when considering the overlapping PUCCH or PUSCH, the timeline becomes an issue.Consider a simple example in Figure 1, whether the SPS HARQ-ACK is deferred depends on the status of HP SR. For a positive SR, the SPS HARQ-ACK is deferred. However, for a negative SR, the SPS HARQ-ACK is not deferred. If UE determines the SPS HARQ-ACK deferral early, for example, at the start of slot 0, the SPS HARQ-ACK should be deferred since the UL traffic has not arrived yet and the SR is negative. However, if the UE determines the SPS HARQ-ACK deferral late, for example, at the end of slot 0 the SPS HARQ-ACK should not be deferred because the SR becomes positive. For deferred SPS HARQ-ACK, it takes time for a UE to generate the HARQ-ACK codebook and encode the UCI bits when multiplexing the UCI in a PUCCH, for example, Tproc is the processing time as shown in Figure 1. If the determination is performed after T0, there will be no enough time to ensure the multiplexing procedure.**Figure 1**The timeline for multiplexing the deferred SPS HARQ-ACK in a PUSCH should also be considered as well. Consider another example in Figure 2, for multiplexing in a PUSCH, a UE should first determine the HARQ-ACK codebook and then determines the PUCCH for carrying the HARQ-ACK and finally the UE determines whether the HARQ-ACK is multiplexed in an overlapping PUSCH.**Figure 2**To address the issue, the time when a UE determines the SPS HARQ-ACK deferral should be specified. A simple solution could be that the UE determines the SPS HARQ-ACK deferral *N* symbols before the end of the current PUCCH slot. The value of *N* can reuse the values for PUSCH preparation time *N2* as defined in TS 38.214.**Proposal: For SPS HARQ-ACK deferral, a UE determines the SPS HARQ-ACK deferral *N2* symbols as defined in TS 38.214 before the end of the slot of the PUCCH with SPS HARQ-ACK.** |

* 1. Initial (pre-meeting) moderator assessment & suggested handling during RAN1#110bis-e

**(Initial) Moderator assessment:**

* The moderator thinks that some correction to argumentation would be needed here, as the yellow parts and the green parts above are not aligned. From moderator perspective, the yellow part should be updated as:

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| --- |
| Consider a simple example in Figure 1, whether the SPS HARQ-ACK is deferred depends on the status of HP SR. For a positive SR, the SPS HARQ-ACK is **NOT** deferred. However, for a negative SR, the SPS HARQ-ACK is **~~not~~** deferred. If UE determines the SPS HARQ-ACK deferral early, for example, at the start of slot 0, the SPS HARQ-ACK should be deferred since the UL traffic has not arrived yet and the SR is negative. However, if the UE determines the SPS HARQ-ACK deferral late, for example, at the end of slot 0 the SPS HARQ-ACK should not be deferred because the SR becomes positive. For deferred SPS HARQ-ACK, it takes time for a UE to generate the HARQ-ACK codebook and encode the UCI bits when multiplexing the UCI in a PUCCH, for example, Tproc is the processing time as shown in Figure 1. |

* Now to the timeline example, it is moderators understanding that for SR there is no multiplexing timeline defined as there is no timing defined for the SR. The UE implementation will just need to guarantee for the case of SR (when delivered by higher layers) that the resulting multiplexing is performed as defined. For all other UCI multiplexing cases within a PHY priority the Rel-15 PHY multiplexing timeline applies as well as for the PHY prioritization the PHY prioritization timeline (if applicable)
	+ Therefore, it is moderator’s understanding similarly here, UE implementation will need to guarantee for the case of (HP or LP SR) that it can process according to the specifications.
	+ For any other cases than SR, the multiplexing & PHY prioritization timelines are in place already.
* Therefore, the need for defining some timeline (at least for the specific example of pos / neg SR) are a bit unclear to the moderator.

**Moderator suggested handling:**

* **Treat this issues during RAN1#110bis-e (at least to clarify if a timeline is needed or not)**
* But further clarification from Samsung would be appreciated early in RAN1#110, if the timeline is needed for the case of SR only – and / or for other UCI than SR as well.
	1. Issue to be handled during RAN1#110bis-e?

**Question: Do you support discussing Issue#6 during RAN1#110bis-e?**

|  |  |
| --- | --- |
| Yes - support:  | CATT, Samsung,  |
| No - not support:  | Intel  |

**Comments on the moderator comments / suggested handling or on the proposal & draft CR:**

|  |  |
| --- | --- |
| *Company* | *Comments*  |
| CATT | We share the similar understanding with moderator but we are fine to discuss the issue and hear more views. |
| OPPO | To our understanding, the timeline issue only occurs for SR, but does not exist for other UCI(s), e.g. HARQ-ACK. If it is correct understanding, we prefer to leave it to UE implementation. |
| LG | Since both SPS HARQ-ACK and SR are semi-static, we think it would not make scheduling restricsion at gNB side. We share moderator’s view on the necessity of timeline. |
| Intel  | We understand the issue, but as explained by FL, the timeline for SR is always handled by UE implementation. We are open to hear more views.  |
| Nokia/NSB | Not opposing here, but we don’t see a need for the timeline for SR (leave to UE implementation as OPPO pointed out). So maybe Samsung could clarify a bit more on the need.  |
| Samsung | Yes, the main case is for positive HP SR (there are other cases but we think they do not have timeline issues). To clarify, the issue is not about having the UE implementation handle positive SR – that would be OK. The issue is about specifications being unclear for the case that LP/HP multiplexing/prioritization timelines are not satisfied and then the corresponding procedures are not applicable. Then, the question is whether UE drops HP SR and then also drops the LP HARQ-ACK due to collision with semi-static DL, or whether the UE drops the LP HARQ-ACK first (due to collision with semi-static DL and as the UE knows the cancelation timeline cannot be fulfilled in order to apply multiplexing/prioritization) and then the UE can transmit the HP SR. |
| New H3C | We share the same view with FL and other companies. This issue can leave to UE implementation. |
| vivo | We share moderator’s views. |
| ZTE | We agree with the assessment from FL, the timeline for SR is always handled by UE implementation. |
| DOCOMO | Share moderator’s views. |
| Huawei, HiSilicon | We are fine to discuss to have clear understanding.  |
| Moderator | Please see the further explanation by Samsung and provide further input (include in the table to support / not support discussing) |
| Intel  | Similar to SR timeline in issue #1, we prefer to up to UE implementation or avoid by gNB scheduling.  |
| vivo | Based on Samsung’s reply, we think for Rel-17 inra-UE MUX with different prioritises, after MUX HP channels and LP channels, then check whether there is overlapping between the final channel and semi-static DL/SSB ect. So, no issue here? |
| Samsung | @Vivo: If a UE drops HP SR because the LP A/N cancelation timeline is not satisfied, and the drops the LP A/N due to semi-static DL/SSB, the UE ends up transmitting nothing. But the UE knows the LP A/N will be dropped (semi-static DL/SSB). Then why should the UE drop HP SR?  |
| vivo2 | Thanks Samsung for the explanation. For the case you mentioned involving the SR, we agree with other companies that it depends on UE implementation to ensure the timeline that the triggered HP SR can cancel the LP A/N and transmitted.  |

# Issue#7: Timing for PUCCH cell pattern applicability

* 1. Companies’ inputs

The issue had been discussed already in RAN1#109-e and RAN1#110.

The related question from RAN1#109-e reads as:

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| **Question 2.7.1: Which of the following points (A…E) from the following CATT proposal do you support:** ***For semi-static PUCCH carrier switching, UE applies PUCCH cell switching pattern based on the following time point:***1. ***If UE receives in a PDSCH an activation command for the SCell ending in slot n, UE applies the PUCCH cell switching time-domain pattern from the first PCell slot after SCell is active, where the active timing is determined based on the minimum requirement defined in [10, TS 38.133].***
2. ***If UE receives in a PDSCH a deactivation command for the SCell ending in slot n, the UE would not apply the PUCCH cell switching time-domain pattern from slot n***$+k$***, where slot*** $n+k$ ***is defined in section 4.3 of TS38.213.***
3. ***If the sCellDeactivationTimer associated with the SCell expires in slot n, the UE would not apply the PUCCH cell switching time-domain pattern from the first PCell slot that is after slot  where  is the SCS configuration for PDSCH reception on the secondary cell.***
4. ***If UE detects a DCI indicating SCell dormancy, the UE would not apply the PUCCH cell switching time-domain pattern from the first PCell slot after slot*** $n+3N\_{slot}^{subframe,µ}$***, where slot*** $n$ ***is the slot indicated for PUCCH transmission with HARQ-ACK information corresponding to the DCI and  is the SCS configuration for the PUCCH.***
5. ***If UE detects a DCI indicating SCell from dormancy to active, the UE apply the PUCCH cell switching time-domain pattern from the first PCell slot after the time duration specified in [10, TS 38.133].***
 |

**QC** (in [**R1-2209946**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209946.zip)) suggesting to **support cases A to E, but based on different timelines as discussed in their earlier RAN1#110 contribution (**[R1-2207190](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2207190.zip)**) already**

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| **Proposal 1: For semi-static PUCCH cell switch, if a *UE receives in a PDSCH in slot n an activation command for a SCell, the UE can apply the PUCCH cell switching time-domain pattern no earlier than slot n+k, where*** $k=m+3 N\_{slot}^{subframe,μ}+1$ ***, and slot n+m is a slot indicated for PUCCH transmission with HARQ-ACK information for the PDSCH reception*.** **Proposal 2: For semi-static PUCCH cell switch, if a *UE receives in a PDSCH in slot n a deactivation command for a SCell, the UE stop to apply the PUCCH cell switching time-domain pattern after slot n+k, where*** $k=m+3 N\_{slot}^{subframe,μ}+1$ ***and slot n+m is a slot indicated for PUCCH transmission with HARQ-ACK information for the PDSCH reception*.** **Proposal 3: For semi-static PUCCH cell switch, if sCellDeactivationTimer expires *in slot n for a SCell, the UE stop to apply the PUCCH cell switching time-domain pattern after slot n+k, where*** $k=3 N\_{slot}^{subframe,μ}+1$**.** **Proposal 4: For semi-static PUCCH cell switch, if a *UE receives in a PDCCH in slot n with a DCI to turn an active Scell into dormancy, the UE stop to apply the PUCCH cell switching time-domain pattern after slot n+min(k,TdormantBWPswitchDelay), where*** $k=m+3 N\_{slot}^{subframe,μ}+1$ ***and slot n+m is a slot indicated for PUCCH transmission with HARQ-ACK information for the PDSCH reception*.** **Proposal 5: For semi-static PUCCH cell switch, if a *UE receives in a PDCCH in slot n with a DCI to turn a darmant Scell into active, the UE apply the PUCCH cell switching time-domain pattern after slot n+TdormantBWPswitchDelay.*** |

* 1. Initial (pre-meeting) moderator assessment & suggested handling during RAN1#110bis-e

**(Initial) Moderator assessment:**

* The issue had been discussed already in RAN1#109-e
* In RAN1#110 we had further discussed (incl. the QC proposed handling above) in Toulouse with the following offline discussion outcome (see RAN1#110 moderator summary in [R1-2208102](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2208102.zip))

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| 2.4.6 Report from ‘offline’ discussion (without GTW) between interested companies on Thu 25th (afternoon coffee break)The following companies participated an offline discussion (without GTW access / locally only): Moderator / Nokia (Klaus), Samsung (Aris), Huawei (Chengyan), Ericsson (Sorour), Qualcomm (Yi), vivo (Lihui), LG (Duckhyun) and Apple (Weidong) **Discussion summary:** The situation was discussed again, and companies felt that specifying a time-line may not be absolutely needed (i.e. nothing is broken, can be handled by gNB implementation / gNB to handle the uncertainties). **Discussion outcome / conclusion:** The related discussions are to be stopped at this point and there is no intention come back to this issue in Rel-17 URLLC maintenance.  |

* The related discussions in RAN1#110 ended with the tendency to not continue the related discussions any further. So from this perspective, moderator suggesting to not re-discuss the issue.
* If nevertheless this is to discussed, we may need to bring back the different options proposed also by other companies to RAN1#110 as well (of Sec. 2.4.1 in RAN1#110 summary of [R1-2208102](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110/Docs/R1-2208102.zip))
	1. Issue to be handled during RAN1#110bis-e?

**Question: Do you support discussing Issue #7 during RAN1#110bis-e?**

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| Yes - support:  | QC |
| No - not support:  | Nokia/NSB, Samsung |

**Comments on the moderator comments / suggested handling or any other comments:**

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| *Company* | *Comments*  |
| CATT | Our understanding of the conclusion in last meeting is to stop discussing the issue. But as one proponent of the issue, we would be ok to discuss the issue in this meeting if we bring back the different options proposed in last meeting as proposed by moderator.  |
| Nokia/NSB | Same understanding with CATT on the conclusion. Looking at the situation of the discussions in Toulouse in Aug, there seems to be no real convergence here.  |
| Samsung | It is surprising to see that proposal as we concluded to stop discussion. Qualcomm was present. Again, the issue is similar to PDCCH capability partitioning in case of sSCell activation/deactivation for Rel-17 DSS (was discussed and the conclusion was to leave it to gNB implementation – Qualcomm proposed/agreed). Also, the issue (some timing uncertainty) always exists for any RRC-based activation/deactivation (again, gNB implementation handles timing for any case involving enabling/disabling functionalities by RRC).  |
| vivo | Share the understanding with CATT on the conclusion made in last meeting. |
| Huawei, HiSilicon  | Our understanding of the conclusion in last meeting is to stop discussing the issue. |
| QC | There were two V008 and our input in the first-round discussion was lost. Although it might not change the outcome of discussion, we add our input back for the record. Maybe I missed or had to leave that offline offline session early, because I don’t recall we discussed this issue. (I recall we discussed issue #1 in an offline offline.) I had an impression that the issue was not treated in last meeting because there was only limited time, rather than we have concluded to stop discussing this issue. Anyway, we think at least case A should be fixed. Current spec defined CSI feedback timeline for Scell activation. HARQ-ACK feedback is more important than CSI. And the proposal is simply following the CSI timeline, which is quite straightforward.  |

# Outcome

TBA