**3GPP TSG-RAN WG4 Meeting # 100-e R4-2115338**

**Electronic Meeting, August 16-27, 2021**

**Agenda item:** 9.10.2.3

**Source:** CATT

**Title:** WF on further RRM enhancement for NR and MR-DC - PUCCH SCell activation/deactivation requirements

**Document for:** Approval

### Sub-topic 1-1 Ending point of PUCCH SCell activation

#### Issue 1-1-1: The ending point of PUCCH SCell activation for invalid TA case?

Tentative agreement:

For invalid TA case, the ending point of PUCCH SCell activation should be the point when UE transmit valid CSI report on the target PUCCH SCell.

### Sub-topic 1-2 Beam information for PUCCH SCell activation

#### Issue 1-2-1: How to indicate the beam information for PUCCH Scell activation for unknown cell (The procedure for beam indication for PUCCH Scell activation)?

Tentative agreement:

~~RAN4 send LS to RAN1/2 asking for the feasibility and potential solutions for transmitting the beam information of PUCCH Scell on the Pcell/PSCell~~.

[Qualcomm]

*Reason of change is because the detailed cases where issues are identified should be clearly stated in the LS to other working groups. And it would be good to let other working groups know RAN4 sees benefits in supporting those cases if supported by the current RAN1 and RAN2 spec or spec updates. We don’t think it is necessary to list candidate solutions that have been mentioned just for discussion purposes, i.e. not thoroughly checked by all companies and not in RAN4’s area of expertise With this understanding, our recommendation is as below:.*

RAN4 sends LS to RAN1 and RAN2 with the following finding and requests:

* RAN4 identified PUCCH SCell activation is not fully supported by the current specification for the following cases:
	+ unknown FR2 PUCCH SCell activation with a valid TA
		- Due to the possibility that the spatial relation of PUCCH of the to-be-activated PUCCH SCell might be outdated, L1-RSRP report may not be able to properly reported to the PUCCH SCell.
	+ unknown FR1 PUCCH SCell activation without a valid TA
		- Due to lack of a proper DL TCI association, PDCCH triggering CFRA for the to-be-activated PUCCH SCell may not be received by the UE
	+ unknown FR2 PUCCH SCell activation without a valid TA
		- Due to lack of a proper DL TCI association, PDCCH triggering CFRA for the to-be-activated PUCCH SCell may not be received by the UE
	+ Note that unknown conditions for FR1 and FR2 SCells are based on 8.3.2 of TS38.133.
* RAN4 sees benefits in supporting PUCCH SCell activation for the above cases in terms of network operation flexibility and UE power consumption.
* RAN4 would like to kindly ask RAN1 and RAN2 if PUCCH SCell activation for the above cases can be supported by RAN1 and/or RAN2 spec update. If so, please inform RAN4 what would be the activation sequences for each case.

#### Issue 1-2-2: Whether the CSI reporting type (periodic, aperiodic, semi-persistent) about PUCCH SCell activation is needed to be specified?

* Option 1: (NTT DOCOMO, Nokia)
	+ No. Any kind of reporting type can be used for the PUCCH SCell activation procedure.
* Option 2: (Apple, OPPO)
	+ Periodic and semi-persistent CSI reporting shall be considered for PUCCH SCell activation, like the legacy SCell activation requirement. FFS for aperiodic CSI reporting.
* Option 3: (MTK, Qualcomm, Huawei, CATT)
	+ FFS.

#### Issue 1-2-3: Whether the beam information (L1-RSRP measurement result) of PUCCH SCell for TCI determination is needed or not for unknown cell?

* Option 1: (NTT DOCOMO)
	+ If UE can report CSI of PUCCH Scell via SpCell or CBRA can be supported on PUCCH Scell, beam information (L1-RSRP measurement result) of PUCCH Scell for TCI determination is not needed.
* Option 2: (Apple, CATT, Qualcomm, vivo, OPPO, Ericsson, Intel)
	+ Same as the beam information indication for determining the associated SSB in PDCCH order for RA.
	+ If the target PUCCH Scell is unknown cell in FR2:
		- If there is at least one active serving cell on that FR2 band (following the same conditions in TS38.133 section 8.3.2 for intra-band FR2 Scell activation), no need to indicate the beam information of PUCCH Scell to network for TCI determination.
		- Otherwise, need to indicate the beam information of PUCCH Scell to network for TCI determination.
	+ If the target PUCCH Scell is unknown cell in FR1:
		- If it is contiguous to an active serving cell in the same band (following the same conditions in TS38.133 section 8.3.2 for intra-band contiguous FR1 Scell activation), no need to indicate the beam information of PUCCH Scell to network for TCI determination.
		- Otherwise, need to indicate the beam information of PUCCH Scell to network for TCI determination.
* Option 3: (Huawei, Xiaomi)
	+ Beam information is need for unknown PUCCH Scell activation for TCI determination for both valid TA and invalid TA and both FR1 and FR2.
* Option 4: (Nokia)
	+ Beam information is need for unknown PUCCH Scell activation for TCI determination for both valid TA and invalid TA.

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| **Issue 1-2-3: Whether the beam information (L1-RSRP measurement result) of PUCCH SCell for TCI determination is needed or not for unknown cell?** |
| **Company** | **Comments** |
| Xiaomi | Option 3 |
| Apple | Option 2 |
| Qualcomm | Option 1 is already out of the current spec.Option 3 and 4 correspond to “otherwise’ in Option 2.Option 4 is the more precise and doesn’t violate the current specification.Support Option 4. |
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#### Issue 1-2-4: Whether the UL spatial relation is needed for PUCCH SCell activation in FR2 for invalid TA case?

Agreement:

The UL spatial relation is needed for PUCCH SCell activation in FR2 for invalid TA case.

#### Issue 1-2-5: If the answer of issue 1-2-4 is yes, whether the extra delay time due to UL spatial relation activation is needed for PUCCH SCell activation requirements?

* Option 1: (NTT DOCOMO, Nokia)
	+ No. The PUCCH Scell activation delay is defined assuming the spatial relation activation command and TCI activation command are received in the same MAC CE.
* Option 2: (Apple, Xiaomi, MTK, vivo, OPPO, Ericsson, Qualcomm, Huawei, ZTE, CATT, Intel)
	+ Yes. The time uncertainty of the MAC CE for UL spatial relation activation of PUCCH in target being-activated SCell shall be considered

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| **Issue 1-2-5: If the answer of issue 1-2-4 is yes, whether the extra delay time due to UL spatial relation activation is needed for PUCCH SCell activation requirements?** |
| **Company** | **Comments** |
| Xiaomi | Support option 2. |
| Apple | Option 2. |
| Qualcomm | The current specification doesn’t guarantee Option 1. If Option 2 can include Option 1, i.e. the time uncertainty can be ignored if spatial relation activation command and TCI activation command are received in the same MAC CE, Option 2 should be a more generic approach. |
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### Sub-topic 1-3 PUCCH SCell activation requirements applicability regarding to UE capability

#### Issue 1-3-1: PUCCH SCell activation requirements applicability regarding to UE capability?

Agreements:

For Ues do not support *beamCorrespondenceWithoutUL-BeamSweeping*, FR2 PUCCH Scell (de)activation requirements are not applied.

### Sub-topic 1-4 PUCCH Scell activation delay requirement for valid TA case

#### Issue 1-4-1: Whether the Tx power of target PUCCH should be considered in PUCCH SCell activation requirements?

Agreements:

The Tx power of target PUCCH should be considered in PUCCH SCell activation requirements.

#### Issue 1-4-2: PUCCH Scell activation delay requirement for valid TA case?

* Option 1: (NTT DOCOMO, Huawei, Nokia)
	+ Reuse the Rel-15 SCell activation delay requirement for valid TA case, i.e. (( THARQ + Tactivation\_time +TCSI\_Reporting)/ NR slot length).
* Option 2: (Apple, MTK, Qualcomm, vivo, Xiaomi, OPPO, Ericsson, CATT, Intel, CMCC)
	+ In FR1, reuse the Rel-15 SCell activation delay requirement which is (( THARQ + Tactivation\_time +TCSI\_Reporting)/ NR slot length).
	+ In FR2, use normal SCell activation delay (i.e., (THARQ + Tactivation\_time +TCSI\_Reporting)/ NR slot length ) in TS38.133 section 8.3.2 as baseline, but the time uncertainty of the single MAC CE for both UL spatial relation and PL-RS activation of PUCCH in target being-activated SCell shall be considered in the baseline Tactivation\_time.

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| **Issue 1-4-2: PUCCH Scell activation delay requirement for valid TA case?** |
| **Company** | **Comments** |
| Xiaomi | Support option 2 |
| Apple | Option 2 |
| Qualcomm | Support Option 2. And the proposal of FR2 in Option 2 shall be clarified that it, as of now, applies to known cell case, i.e. unknown cell case is going to be addressed later separately. |
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### Sub-topic 1-5 PUCCH Scell activation delay requirement for invalid TA case

#### Issue 1-5-1: The PUCCH SCell activation requirements for invalid TA case

* Option 1: (CATT)
	+ Delay = (( THARQ + Tactivation\_time + TCSI\_Reporting + TPDCCH + T1 + T2 + T3)/ NR slot length) for invalid TA case.
		- TPDCCH is time from the end of basic SCell activation to the start of PDCCH signal receiving for PRACH transmission.
		- If the PDCCH signal is sent during TCSI\_Reporting, TPDCCH = 0.
* Option 2: (NTT DOCOMO, Apple, Xiaomi, MTK, vivo, OPPO, Ericsson, Qualcomm, Huawei, Intel)
	+ If UE does not have the valid TA on the PUCCH Scell being activated, an additional UL synchronization procedure to obtain the valid TA comparing to ( THARQ + Tactivation\_time +TCSI\_Reporting) shall be considered which including the following factors:
		- the delay uncertainty in acquiring the first available PRACH occasion in the PUCCH Scell(T1);
		- the delay for obtaining a valid TA command for the sTAG to which the Scell configured with PUCCH belongs(T2);
		- the delay for applying the received TA for uplink transmission(T3)
* Option 3: (CMCC)
	+ For DL, the Scell activation delay is: (( THARQ + Tactivation\_time +TCSI\_Reporting)/ NR slot length)
	+ For UL, the Scell activation delay is: except THARQ + Tactivation\_time +TCSI\_Reporting, additional delay including following parts need to be considered for the Scell activation delay requirements specification:
		- the delay uncertainty in acquiring the first available PRACH occasion in the PUCCH Scell
		- the delay for obtaining a valid TA command for the sTAG
		- the delay for applying the received TA for uplink transmission
* Option 4: (Nokia)
	+ If the UE does not have a valid TA for transmitting on an Scell, the UE shall be capable to perform downlink actions related to the Scell activation command for the Scell being activated on the PUCCH Scell no later than in slot $n+\frac{T\_{HARQ}+T\_{activation\\_time}}{NR slot length}$.
	+ If the UE does not have a valid TA for transmitting on an Scell, the UE shall be capable to perform uplink actions related to the Scell activation command for the Scell being activated on the PUCCH Scell no later than in slot $n+\frac{T\_{HARQ}+T\_{activation\\_time}+T\_{RACH}}{NR slot length}$, where TRACH is the delay to perform RACH procedure and apply the TA.
	+ The activation delay requirement for PUCCH Scell shall be defined assuming no dedicated time period for CSI measurements and reporting.

#### Issue 1-5-2: Whether to define separated requirements for downlink actions and uplink actions?

Tentative agreements:

The timeline for downlink actions and uplink actions could be clarified in the spec similar as LTE, but the single requirement shall be specified covering DL/UL actions for PUCCH Scell activation with invalid TA.

#### Issue 1-5-3: the delay for obtaining a valid TA command for the sTAG to which the Scell configured with PUCCH belongs (i.e. T2)

* Option 1: (MTK, Apple, Qualcomm, vivo, Xiaomi, NTT DOCOMO, OPPO, Ericsson, Huawei, CATT, Intel)
	+ T2 is the delay from slot n + (Tactivate\_basic +T1)/NR slot length until UE has obtained a valid TA command for the target PUCCH Scell being activated. Tactivate\_basic is the normal Scell activation delay in TS38.133 section 8.3.2. slot n is the slot when UE received PUCCH Scell activation MAC CE.
* Option 1a: (NTT DOCOMO)
	+ T2 shall be up to 80 slots, which is maximum value of RAR window duration.
* Option 2: (Nokia)
	+ T2 is the delay from slot n + (THARQ + Tactivatation\_time +T1)/NR slot length until UE has obtained a valid TA command for the target PUCCH Scell being activated. Tactivatation\_time is defined in TS38.133 section 8.3.2. slot n is the slot when UE received PUCCH Scell activation MAC CE.

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| **Issue 1-5-3: the delay for obtaining a valid TA command for the sTAG to which the Scell configured with PUCCH belongs (i.e. T2)** |
| **Company** | **Comments** |
| Xiaomi | Option 1 |
| Apple | Option 1 |
| Qualcomm | Support Option 1. |
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#### Issue 1-5-4: the delay for applying the received TA for uplink transmission on target PUCCH Scell being activated (i.e. T3)

Agreements:

T3 is the delay for applying the received TA for uplink transmission on target PUCCH Scell being activated, and greater than or equal to k+1 slot, where k is defined in clause 4.2 in TS 38.213.

### Sub-topic 1-6 Interruption requirements for PUCCH SCell activation in invalide TA case

#### Issue 1-6-1: Interruption requirements for PUCCH SCell activation in invalide TA case

RAN4 further study the possibility of interruption due to PRACH based on the following options:

* Option 1: (CATT, Nokia)
	+ Reuse the interruption requirement of normal Scell activation (i.e. not to define the interruption requirement due to PRACH)
* Option 2: (Apple, OPPO, Qualcomm)
	+ The interruption requirement shall include the existing requirement for Scell activation in Rel-15.
	+ Introduce additional interruption by PRACH transmission when target PUCCH Scell RACH has different SCS from spCell data/control channel and UE does not support diffNumerologyAcrossPUCCH-Group.
	+ Need to revisit R15 RACH requirement
* Option 3: (Ericsson, Huawei, Nokia)
	+ Ask RAN1 whether this is a valid case and how to prioritize between the channels

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| **Issue 1-6-1: Interruption requirements for PUCCH SCell activation in invalide TA case** |
| **Company** | **Comments** |
| Apple | Option 2, but we are open to FFS on “to revisit R15 RACH requirement” |
| Qualcomm | Support Option 2. And we’d like to propose to put the last sub bullet “Need to revisit R15 RACH requirement” on FFS and add “for unknown PUCCH SCell activation, whether or not there can be additional interruptions is up to the final solution, if supported. |
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### Sub-topic 1-7 Applicability of PUCCH SCell activation requirements

#### Issue 1-7-1 Applicability on interruption:

* Option 1: (Apple, CATT)
	+ No interruption occurs in same FR as the target PUCCH Scell during the Scell activation procedure if UE supports per-FR MG, otherwise the PUCCH Scell activation delay can be extended, and
	+ No interruption occurs during the Scell activation procedure if UE does not support per-FR MG, otherwise the PUCCH Scell activation delay can be extended.
	+ The above interruption is caused by factor defined in TS38.133 section 8.2.1.1 for EN-DC, in TS38.133 section 8.2.2.1 for NR SA, in TS38.133 section 8.2.3.1 for NE-DC and in TS38.133 section 8.2.4.1 for NR-DC.
* Option 2: (MTK)
	+ No interruption occurs in same FR as the target PUCCH Scell during other concurrent Scell activation procedure if UE supports per-FR MG, otherwise the PUCCH Scell activation delay can be extended, and
	+ No interruption occurs during other concurrent Scell activation procedure if UE does not support per-FR MG, otherwise the PUCCH Scell activation delay can be extended.

#### Issue 1-7-2: Applicability on PDCCH order receiving:

* Option 1: (CATT, Qualcomm)
	+ The UE has received a PDCCH order to initiate RA procedure on the PUCCH Scell within TCSI\_Reporting (can’t earlier than THARQ + Tactivation\_time) otherwise additional delay to activate the Scell is expected as TPDCCH defined in issue 1-5-1.
* Option 2: (Apple, Nokia)
	+ The UE has received a PDCCH order to initiate RA procedure on the PUCCH SCell within Tactivate\_basic otherwise additional delay to activate the SCell is expected.
* Option 3: (Ericsson)
	+ Delay requirements for PUCCH Scell activation shall account for additional time when PDCCH order is received outside Tactivate\_basic. The additional time shall be accounted for by an expression and/or a delay component, e.g. max(Tactivate\_basic, TPDCCH\_order).

#### Issue 1-7-3: Applicability on SSB configuration:

* Option 1: (MTK, Qualcomm, vivo, CATT)
	+ No requirement defined when SSB configuration for target PUCCH Scell is not provided.

#### Issue 1-7-4: Applicability on use cases:

* Option 1: (vivo, OPPO)
	+ RAN4 to discuss and clarify whether the following cases are valid and/or to be considered for PUCCH Scell (de)activation requirements.
		- Single-TAG vs. Multi-TAG for Dual PUCCH
		- Intra- vs. Inter-band between PUCCH cells
* Option 2: (MTK, Huawei, CATT)
	+ There is no needed to bundle the PUCCH Scell with single/multiple TAGs or intra-/inter band cases.

#### Issue 1-7-5 Applicability on multiple SCells:

* Option 1: (Ericsson)
	+ In activation of multiple Scells with one PUCCH Scell, activation delay requirement shall apply at least for the PUCCH Scell in the event that one or more Scells have configurations that render parallel activation impossible for the UE. FFS on whether activation delay requirement also is to apply for Scells that are compatible with parallel activation with PUCCH Scell.

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| **Sub-topic 1-7 Applicability of PUCCH SCell activation requirements** |
| **Company** | **Comments** |
| Apple | Issue 1-7-1 Applicability on interruption: Option 1.Issue 1-7-2: Applicability on PDCCH order receiving: Option 2Issue 1-7-3: Applicability on SSB configuration: If option 1 means no requirement applies for SSB-less PUCCH SCell, we are fine with this option 1. But the wording of this option needs to be revised since the ’SSB configuration’ is unclear (’SSB-less’ or ’SSB configuration is not provided but UE can do blind detection’).* No requirement defined when the target PUCCH SCell is a SSB-less SCell.
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| Qualcomm | Issue 1-7-1 Applicability on interruption: Option 1. And to us, ”other concurrent Scell activation procedure” in Option 2 seems to be related to Issue 1-7-5. If that is the case, that can be further considered later.Issue 1-7-2: Applicability on PDCCH order receiving: We would like to leave both options open and revisit the issue in the next meeting.Issue 1-7-3: Applicability on SSB configuration: We share a similar view as Apple. We are okay with the Apple’s suggestion above.Issue 1-7-4: Applicability on use cases: We would like to leave both options open and revisit the issue in the next meeting.Issue 1-7-5 Applicability on multiple SCells: We would like to leave both options open and revisit the issue in the next meeting. |
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