3GPP TSG-RAN WG2 #113-e R2-210xxxx

eMeeting, 12th – 20th April, 2021

Agenda Item: 6.5.2

Source: MediaTek Inc.

**Title: Report of [Post113-e][224][DCCA] TCI state indication at direct SCell activation (MediaTek)**

Document for: Discussion and decision

# 1 Introduction

This is report for the following AT113-e mail discussion.

* [Post113-e][224][DCCA] TCI state indication at direct SCell activation (MediaTek)

 Scope: Discuss what is needed in RAN2 for TCI state indication at direct SCell activation based on latest RAN1 LS (should consider also earlier RAN2 meeting discussion).

 Intended outcome: Discussion report and agreeable CR (if needed)

 Deadline: Long

# 2 Contact Points

Respondents to the email discussion are kindly asked to fill in the following table.

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| Company | Name | Email Address |
| MediaTek (Rapporteur) | Felix Tsai | Chun-Fan.tsai@mediatek.com |
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# 3 Discussion on TCI State for Direct SCell activation

## 3.1 Background

The TCI state issue for direction SCell activation is triggered by RAN4 LS R2-2100058 [1]. According to RAN4, the TCI state information is required for NR FR1 or FR2 SCell activation.

RAN4 would like to inform RAN1/RAN2 that TCI state activation is required as part of the SCell activation procedure in NR. Current RRC command for direct SCell activation does not include TCI state activation information to UE. In current framework, network needs to send separate MAC CE to complete direct SCell activation procedure. Due to this both gNB and UE may not realise the full benefit of direction SCell activation feature using existing framework. The above mentioned issue applies to both FR1 and FR2.

Then RAN1 also discussed this issue and send a reply LS in R2-2102199 [2]. According to RAN1, TCI state is required for some case if more than one TCI state is configured. But they have no intention to define RAN1 based solution for this.

RAN1 thanks RAN4 for the LS regarding TCI state indication at Direct SCell activation. RAN1 understands that in current framework, a TCI state activation is required in some cases (e.g. inter-band CA) in addition to the RRC activation command to complete the direct SCell activation procedure if more than one TCI states are configured. It is mentioned by RAN4 that the solution to the issue is RAN1/RAN2 aspect. However, from RAN1 perspective, no further RAN1-based enhancement for this issue is intended in Rel-16.

In the last RAN2 meeting, the issue is postponed to wait RAN1 LS. Since now RAN1 LS is arrived, RAN2 could discuss the action on this issue.

## 3.2 Discussion

According to RAN4/RAN1 LS, the TCI state information is needed for direct SCell activation at least for some cases. Since RAN1 solution is not adopted, RAN2 should discuss whether we need RAN2 based solution. In our understanding, the RAN2 based solution would be simply add the TCI state information via RRC for direct SCell activation.

**Question 1: Do companies intend to have RAN2-based solution for TCI state issue (i.e. Add TCI state in RRC for direct SCell activation)?**

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| **Company** | **Yes or No** | **Comments** |
| Nokia, Nokia Shanghai Bell | No | This is an optimization: While it would be nice to have a fast solution for this, the fact is that Rel-16 is already frozen and the direct SCell activation feature is not broken - just not optimal. Network can already either just use a single TCI state or use TCI state activation MAC CE after the direct SCell activation to address this. Unless this can be considered to be supported by all UEs without any extra capabilities, we think RAN2 shuoldn't optimize this anymore or add new Rel-16 capabilities. |
| ZTE | Yes | If this is not supported, to achieve the benefit of direct SCell activation, network has to configure only one TCI state in SCell establish RRC message. However, this implies that after SCell setup, network needs to trigger another RRCReconfiguration to reconfigure list of TCI states to UE. To us, this is undesirable due to signalling overhead and possible data interruption. And using MAC CE right after direct SCell activation is exactly the same as normal SCell activation procedure. In our understanding, we cannot simply mark it as an optimization, it is a mistake that was overlooked in the previous discussion. Leave the flaw as it is does not bring much value to Rel-16 deployment. So we are ok to enhance RRC message, and from our perspective, it is not a complex change. |
| Qualcomm  | Yes | 1. In LS from RAN1 and RAN4, both have indicated that TCI state information is needed (at least for some cases). Otherwise, network must send separate MAC CE to complete direct SCell activation procedure, and thereby full benefit of direction SCell activation is not achieved. We think it is a sufficient justification to introduce TCI state in RRC.
2. The RRC spec change will be simple as rapporteur analysed. With regards to concern on backward compatibility expressed by some companies, we think it can be resolved by introducing a simple per-UE capability.

Regarding to Nokia’s comment “it is an optimization”, we do not agree:* We think it is a correction instead of optimization. The intention of direct SCell activation is just to reduce the latency to send activation MAC-CE. Then if another MAC-CE for TCI is still needed to be sent to UE (at least in inter-band CA as RAN1/RAN4 told RAN2), what is the point to support direct SCell activation?
* For other solutions mentioned by Nokia (e.g., a single TCI state), it will make restriction on Network implementation/configuration, and extra latency will be caused for NW to reconfigure via RRC from single TCI state to multiple TCI.
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| OPPO | Yes with comments | I understand the delay of one SCell’s “real” activation will be reduced if RRC message can also includes the activated TCI state of PDCCH and PDSCH for direct SCell activation.However, for MAC CE based SCell activation, there is no force to make the SCell A/D MAC CE and TCI state activation MAC CE in one TB and it is up to gNB implementation.For direct SCell activation, I wonder whether it can be left to gNB implementation and I also agree the concern from Nokia. |
| Huawei, HiSilicon | No  | We share the similar view as Nokia. Our impression according to RAN1 discussion and reply LS is that RAN1 think this issue does not exist in same cases, e.g. only one TCI is configured (MAC CE is not needed) and for other cases this is not a urgent issue for R16, so RAN1 will not specify any solution in R16. We prefer to take the same action in RAN2. This is not only considering R16 is frozen for quite a while and it’s questionable if it is worth introducing new RRC signalling and UE capabilities now, but also because there is no pure RAN2 solution for this. Even though the TCI state is configured by RRC, RAN1 specification impact is inevitable which is not expected by RAN1 clearly. |
| MediaTek | Yes | We think this TCI state aspect is clearly missed while RAN2 designed the direct SCell activation. Without adding this parameter in RRC, basically the direct SCell activation is almost useless. In response to Huawei’s comment on RAN1 impact, we are not sure what would be the additional RAN1 impact for RAN2 based solution. The difference is just we could provide TCI state via RRC, not MAC CE. Both RRC and MAC CE are specified in RAN2 SPEC and physical layer would be simply take the control parameters from higher layer. So, we expect that there will be no RAN1 SPEC impact. |
| Ericsson | No | We share the views of Nokia and Huawei. |
| CATT | No | If only one TCI is configured for the SCell, the problem is not existed.For the case of more than one TCIs are configured for the SCell, how to configure the active TCI should be based on the physical measurement report from UE, in legacy, when the SCell is activated, the UE should active the SCell and perform channel tracking and measurements after receiving SCell activation MAC-CE. And the NW should decide to active which TCI based on the measurement report from the UE. So from this point, considering the UE doesn’t perform the measurement and report the measurement result to the NW, the NW can’t make the accurate decision about the TCI upon the NW active the SCell via RRC signaling. The benefit of the direct SCell activation via RRC signalling is save one additional MAC CE to active the SCell and the reduction of latency for the additional MAC-CE. |
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There are some offline comment that there should be capability bit for this new change. The rapporteur understand that if we agree to have this new RRC parameter, it is also reasonable to have corresponding capability so that the CR would be backward compatible. It is assumed that a simple optional capability bit is enough.

**Question 2: If agree to have RRC configuration of TCI state for direct SCell activation, do companies agree to introduce a new capability for this? (Assuming to be per-UE and optional)**

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| **Company** | **Agree or not** | **Comments** |
| Nokia, Nokia Shanghai Bell | No | We think this can only be agreed if no additional capabilities are needed, i.e. all UEs support any signalling defined for the TCI state update of direct Scell activation.  |
| ZTE | Yes | Although we consider it more like a “bug fix”, it is fine to introduce capability if company has NBC concern.Of course, it would be better if UE mandatorily supports the new fields when UE indicates the support of SCell direct activation feature. |
| Qualcomm | Agree | As we indicated in Question 1, it can resolve the concern on backward compatibility. Furthermore, considering there are some difference on TCI state handling between FR1 and FR2, we think the per-UE capability should have FRx-diff. |
| OPPO | Yes  | For NBC issue, the capability is necessary.  |
| Huawei, HiSilicon | Yes | There would be backward compatibility issue if no corresponding UE capabilities introduced.  |
| MediaTek | Yes | We think that capability define is of course needed to avoid NBC concern. We are open to have this as per UE or as FRX-diff. |
| Ericsson | No | There are already 4 capabilities for direct SCell activation. If agreed, we would hope that it could be covered by these existing capabilities. |
| CATT | Yes | It is fine if company has NBC concern |
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During the RAN2 discussion, there is question about whether the TCI state is only about PDCCH or both PDCCH and PDSCH. The proposed CR [R2-2101853](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2101853.zip) includes both PDCCH and PDSCH. The rapporteur also noticed that TCI state could be provided for SP-CSI and that seems to be used also during SCell activation. Therefore, it would be good to discuss what kind of TCI state information should be provided in RRC.

Note that 38.321 specific the following MAC CE to provide TCI state.

* (PDCCH) 6.1.3.15 TCI State Indication for UE-specific PDCCH MAC CE
* (PDSCH) 6.1.3.14 TCI States Activation/Deactivation for UE-specific PDSCH MAC CE
* (SP CSI-RS) 6.1.3.12 SP CSI-RS/CSI-IM Resource Set Activation/Deactivation MAC CE

**Question 3: If agree to have RRC configuration of TCI state for direct SCell activation, which kind(s) of TCI state information should be included ?**

* **(a) TCI state for PDCCH as defined in 38.321 6.1.3.15**
* **(b) TCI state for PDSCH as defined in 38.321 6.1.3.14**
* **(c) TCI state for SP CSI-RS as defined in 38.321 6.1.3.12**

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| **Company** | **Comments** |
| Nokia, Nokia Shanghai Bell | All of these - which already shows that this is not a simple feature (which is why we prefer not to optimize this in Rel-16). |
| ZTE | (b)> (a) =(c)TCI state for PDSCH is needed to inform UE the DL beam for data transmission. So it is more important. TCI state for PDCCH is needed in case of self-scheduling. It is not needed if the SCell is cross-carrier scheduled by another cell. So it can be optional provided.Regarding the TCI state for SP-CSI-RS, based on RAN4 defined requirement in TS 38.133, the SCell activation delay has taken into account the time when UE is capable of transmitting CSI report. So in case SP-CSI-RS is configured for CSI reporting, corresponding TCI state is needed to inform UE the activated SP-CSI-RS resource.

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| ***TS 38.133****Upon receiving the RRC reconfiguration message in slot n, the UE shall be capable to transmit valid CSI report and apply actions for the directly activated SCell no later than in slot* $n+\frac{N\_{direct}}{NR slot length}$ *,**where:* *Ndirect = TRRC\_Process + T1 + Tactivation\_time + TCSI\_Reporting - 3ms*… *If the target SCell is known to UE and semi-persistent CSI-RS is used for CSI reporting, then Tactivation\_time is:**- 3ms + max(Tuncertainty\_MAC + TFineTiming + 2ms, Tuncertainty\_SP), where Tuncertainty\_MAC=0 and Tuncertainty\_SP=0 if UE receives the SCell activation command, semi-persistent CSI-RS activation command and TCI state activation command at the same time.* |

In summary, we think (a), (b) and (c) should all be considered. And we don’t think adding more fields means it becomes complex, as we just copy what we need to RRC signalling.  |
| Qualcomm | Our view is a)>b)>c). Note that the UE anyway needs to first monitor PDCCH, and TCI state of PDSCH can be assumed as same as TCI of PDCCH if *tci-PresentInDCI* is not enabled. For a), it is necessary. Otherwise, network must send separate MAC CE to complete direct SCell activation procedure, and thereby full benefit of direction SCell activation is not achieved.For b), we also think it is necessary because the following two cases can’t be covered by a):* According to current spec, only when IE *tci-PresentInDCI* is not enable, the UE can use/assume TCI state of PDCCH for PDSCH. Then, when the IE is enabled, even if TCI state is indicated in RRC for PDCCH, the NW still need to send separate MAC CE including TCI state of PDSCH.
* It is allowed that SCell has no CORESET (i.e. CORESET is configured in PCell as cross-carrier scheduling). Then in this case, PDSCH TCI is needed for cross-carrier scheduling.

For c), we think it is useful because according to section 8.3.2 of 38.133, the activation latency of direct SCell activation includes the delay of reporting a first valid CSI:=========copy of section 8.3.2 of 38.133Upon receiving SCell activation command in slot *n*, the UE shall be capable to transmit valid CSI report and apply actions related to the activation command for the SCell being activated no later than in slot *n*+ [THARQ + Tactivation\_time + TCSI\_Reporting], where:============================Then, following similar logical of a) and b), it is useful to reduce activation latency by reducing TCSI\_Reporting. But we are fine if majority don’t prefer it. |
| OPPO | Our view is a)>b)>c) |
| Huawei, HiSilicon | a)In our understanding, the most important thing is the DL control beam information. If something has to be done in R16, we prefer a).  |
| MediaTek | In our view, all a), b), c) are needed to complete the direct SCell activation in different scenario. We could just copy the content from MAC-CE and add them as optional parameters in RRC. |
| Ericsson | a, b and c, but we don’t think this is needed in Rel-16.  |
| CATT | All are needed in different scenario, and the a) has highest priority and mandatory. |
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If companies agree to progress on RAN2 based solution, the rapporteurs suggest that we could start from the CR [R2-2101853](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2101853.zip) [3] proposed in last meeting. Besides for the issues discussed in Q3/Q4 above, companies are invited to provide further comment (if any).

**Question 4: If agree to have RRC configuration of TCI state for direct SCell activation, except for the issues discussed above, do companies have further comment on the CR** [R2-2101853](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2101853.zip)**?**

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| **Company** | **Comments** |
| Nokia, Nokia Shanghai Bell | This would also impact RAN4 requirements if RAN2 agrees to this, as well as RAN1 specifications (i.e. how UE takes the TCI state from RRC configuration into use). So it's clear this is not something that can come "for free". |
| ZTE | 1. As replied to Q3, TCI-state for SP-CSI-RS can be added;
2. For PDSCH, maybe “bwp-Id-r16” is not needed? We understand it must be the same as “firstActiveBWP-DL” configured for the SCell.
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| Qualcomm  | * For IE bwp-Id-r16 within SCellPDSCH-TCI, we are not sure whether it is needed. As specified in 38.321, the first active BWP is used upon SCell activation:

=====copy from Section 5.9 of 38.321==============2> if the SCell was deactivated prior to receiving this SCell Activation/Deactivation MAC CE, or an SCell is configured with *sCellState* set to *activated* upon SCell configuration:3> activate the DL BWP and UL BWP indicated by *firstActiveDownlinkBWP-Id* and *firstActiveUplinkBWP-Id* respectively;2> start or restart the *sCellDeactivationTimer* associated with the SCell according to the timing defined in TS 38.213 [6];2> (re-)initialize any suspended configured uplink grants of configured grant Type 1 associated with this SCell according to the stored configuration, if any, and to start in the symbol according to rules in clause 5.8.2;2> trigger PHR according to clause 5.4.6.=============================* For IE sCellPDSCH-TCI-State-r16 within SCellPDSCH-TCI, we think we may not need to use the type of BIT STRING. We understand that rapporteur tried to use the same format in MAC-CE but this design intended for payload size reduction of MAC-CE. In RRC signaling, it is not necessary, and we can just use the type of TCI-StateId, which is more readable.
 |
| OPPO | Agree with ZTE, the BWP id will be the first active BWP configured in RRC signalling. |
| Huawei, HiSilicon | Same view as Nokia. There is RAN1/RAN4 specification impact to support this direct TCI state configuration via RRC. We should consult RAN1 before RAN2 make the agreement especially when RAN1 expressed they do not expect R16 enhancement for this. |
| CATT | Agree with Huawei and Nokia. |
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Finally, companies could raise other comment/suggestion/question if not covered by previous discussion.

**Question 5: Companies are invited to provide other comment (if any) on TCI state for direction SCell activation issue.**

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| **Company** | **Comments** |
| Nokia, Nokia Shanghai Bell | Rel-16 is frozen so we should stop optimizing it: We would actually like the direct SCell activation feature to work well and would support doing this in Rel-17 instead. 3GPP needs to follow its own rules or we will never decrease the workload. |
| ZTE | We prefer to consider it as a “bug fix” instead of an optimization. |
| Qualcomm  | Same view as ZTE |
| OPPO | It is kind of optimization.  |
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# 4 Conclusions

Base on the discussion in section 3, we propose the following:

**Proposal 1:**

# 5 References

[1] R2-2100058 / R4-2017329, “LS on TCI state indication at Direct SCell activation”, RAN4

[2] R2-2102199 / R1-2102015, “Reply LS on TCI state indication at Direct SCell activation”, RAN1

[3] R2-2101853, “TCI state for direct SCell activation”, MediaTek Inc.