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

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

**Agenda Item: 8.13.2**

**Source: Moderator (Huawei)**

**Title: Summary#1 of efficient SCell activation/de-activation mechanism of NR CA**

**Document for: Discussion and Decision**

# Introduction

As per chairman’s guidance, two rounds with check points below are planned. This summary is for the first round and is expected to complete by October 14.

[106bis-e-NR-DSS-02] Email discussion/approval for efficient activation/de-activation mechanism – Frank (Huawei)

* 1st check point: October 14
* Final check point: October 19

According to the contribution papers under agenda item 8.13.2 for efficient activation/de-activation mechanism for NR CA SCells, and in light of the working assumption and agreements achieved the previous meetings, all identified issues are summarized in section and can be discussed in Section 3.

# Summary of issues and priorities

According to all of companies’ contribution documents, all the issues are summarized below, including 5 specific issues and 1 general issues, with more details in Section 3. Please companies provide your views in Section 3 with taking into consideration the information of check points and GTW session.

For the specific issues to activation/deactivation process:

* **Issue-1:** Contents for the triggering signaling
* **Issue-2:** Triggering signaling for SCell activation/de-activation and temporary RS
* **Issue-3:** MAC CE triggering framework
* **Issue-4:** QCL configuration of temporary RS
* **Issue-5:** Enhancement for CSI reporting

For general issues, they are mostly extracted from a proposal of one company:

* **Question G1:** For temporary RS, whether collision handling with uplink slot/symbols should be considered? [6]

According to previous discussions, companies’ top interests and focus seems to be the detailed designs of temporary RS. Therefore, the following discussion order is suggested. Besides any issue is always welcome for any comment, but the first check point and the potential GTW session could focus more on some issues as listed. If any issue reaches potential early consensus based on companies’ feedbacks, it is also surely reviewed by its earliest check point.

## Schedule

* For 1st check point: October 14, and potential GTW session on October 12

Note: The following issues have impacts on details of TRS and potential LS request to RAN4

* **Issue-1: MAC CE triggering framework**
* **Issue-2: MAC-CE signaling for SCell activation/de-activation and temporary RS**
* **Issue-3: Contents for the triggering signaling**
* **Issue-4: QCL configuration of temporary RS**
* For 2nd check point: October 19, and potential new GTW session
* **Follow-ups for all issues listed in 1st check point**
* **The remaining issues with potential consensus**

In case of different views or suggestions on the schedule, they are welcome here.

|  |  |
| --- | --- |
| *Company* | *View* |
| Xiaomi | We are fine with the schedule from FL. Furthermore, we think the general question G1 is critical for TDD band, it deserves further discussion. It should be discussed as early as possible. |
| Qualcomm | We are fine with the schedule suggested by FL.  |
| Futurewei | Support |
| vivo | OK |
| LGE | Support FL’s suggestion |
|  |  |
|  |  |

# Discussions

In current specifications, when a UE receives a SCell activation command in a PDSCH in slot $n$, the UE shall complete SCell activation no earlier than $n+k$ and no later than slot *n*+ [*THARQ* + *Tactivation\_time* + *TCSI\_Reporting*]/$T\_{slotlength}$ as shown in Figure 1. Therefore, reducing *THARQ*, *Tactivation\_time* and *TCSI\_Reporting* is the key to achieve efficient SCell activation/de-activation mechanism. Companies’ views are summarized in the sections below. In addition to your feedback to Section 3, more detailed comments are welcome.



Figure 1 SCell activation procedure

## THARQ reduction

### Issue-1: MAC CE triggering framework

In RAN1#106-e meeting, one remaining issue is the indication how to support temporary RS is triggered for a subset of ‘to-be-activated’ SCells. This issue was extensively discussed in the RAN1 106-e meeting. The following two alternatives were discussed at the last meeting and later email discussion:

Agreement

For triggering temporary RS, down-select based on the following alternatives, or let RAN2 be aware the status of this discussion

* Alt 1: Bitmap approach in MAC-CE
* Every Z-bit block in the bitmap corresponds to a SCell, Z>=0
* A Z-bit block indicates the temporary RS [configuration index], and a value zero indicated by the bit block means no RS resource transmitted.
* The to-be-activated SCell is indicated via the C values in the legacy SCell activation/de-activation MAC CE or in the new MAC-CE
* Alt 2: Reuse A-TRS triggering framework
* A trigger state is indicated by the MAC-CE explicitly
* The association between a trigger state and temporary RS for one or multiple SCells is configured by RRC according Rel-16 A-TRS triggering framework
* FFS: The value zero of the MAC-CE indication means no temporary RS is triggered by the MAC-CE for all to-be-activated SCells

Companies’ views are summarized as follows:

* Opt. 3.1: Bitmap approach in MAC-CE. [1][2][5][6][10][12][17]
* Opt. 3.2: Reuse A-TRS triggering framework.[3][7][8][9][13][15][16]
* Opt. 3.3: Depend on RAN2’ decision. [4]

|  |  |  |
| --- | --- | --- |
|  | Pros | Cons |
| Alt 1 | * For simple and flexible triggering of temporary RS per each of SCells individually, Alt 1 with bitmap approach in MAC-CE is preferable which is similar to the legacy MAC CE signalling structure for SCell activation. [6][12]
* Alt 1 can be considered as a generalization of the existing SCell activation MAC CE, and can provide full flexibility of controlling the triggering RS for each SCell without additional RRC signaling overhead [5]
* Alt 1 as it seems to be more aligned with the traditional MAC CE design and requiring less RRC configurations [5]
 |  |
| Alt 2 | * Lower MAC-CE signaling overhead
* Rel-16 A-CSI triggering framework has been proved to provide sufficient flexibility [13]
* Maximizes reusing existing procedure [9][13][15]
 | * If a gNB wants to indicate triggering temporary RS for all to-be-activated SCells indicated via legacy SCell activation MAC-CE or new MAC-CE, Alt 2 based approach cannot achieve it at least in some cases due to less flexibility.[10]
* The RRC configured scenarios of temp RS and SCell combinations could impose a high overhead and limit the combination of SCells which could be fastly activated. [5] [17]
* The gap between two bursts of temporary RSs is indicated implicitly by two separate triggering offsets for each burst, which is supported by current A-TRS triggering framework yet. [18]
* Redundant IEs cannot be optionally muted out, e.g. *bwp-Id* and *resourceType* under CSI-ResourceConfig. [18]
 |

**Question 3: Any issue/Cons missing for Alt 1? How to address the identified Cons for Alt 2?**

This discussion has impacts on both MAC-CE signaling and the RRC parameters. It is very helpful for the discussion of detailed RRC parameters in the RRC email thread if a down-selection between Alt 1 and Alt 2 is made here. Therefore, **companies are encouraged to address the concerns of the other side**.

To have an overview of the RRC parameters for both Alt. 1 and Alt. 2, two diagrams in Sect 1.1. in [18] could be a reference, as well as the latest version of excel file of RRC parameters in [18].

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Xiaomi | Alt.1 would introduce big overhead for MAC CE. Assuming there are 31 serving cells are configured and 3 bits for each serving cell is needed in order to triggering temporary RS, the overhead would be 31\*3=93 bits. Although alt 2 may increase the overhead of RRC signaling, it is a semi-static overhead and can be controlled by gNB, e.g. network may configure a sub-set of the full list to decrease the overhead. |
| Qualcomm | Agree with Xiaomi. We do not think the “Cons” listed for Alt.2 in the above table are real Cons. |
| Futurewei | Alt 2 would require the same (if not more) bits to support the same amount of combinations as Alt 1. In addition, Alt 2 cannot reuse existing CSI triggering mechanism (due to the number of bursts / gap indication / etc.) or the list. However, if CSI triggering is to be supported during activation to enhance CSI reporting, we think Alt 2 should be used. |
| OPPO | Alt-1 is more flexible in setting the configuration and more aligned with the traditional MAC CE design for SCell activation. So we prefer to Alt 1. |
| vivo | Regarding the MAC CE overhead, I think it is actually depending on the flexibility we want, not the signaling design option. Achieving the same level of flexibility would inevitably requires same MAC CE overhead for both alternatives. On the other hand, we don’t think the MAC CE overhead is a critical issue, especially considering that SCell activation is not a frequent operation. In this sense we prefer Alt.1 as it is more aligned with the traditional MAC CE design and requiring less RRC configurations. If RAN1 cannot achieve a consensus, we can leave it to RAN2 as anyway it is RAN2’s responsibility on MAC CE design. |
| LG Electronics | We prefer Alt.1 and a few detailed comments are below.Alt.2 doesn’t have simplicity and flexibility compared to Alt.1. In excel file of RRC parameters in [18], Alt 2 need more RRC parameters for configuration. In new MAC CE, the number of to-be-activated SCells which is corresponding to each Temporary RS State ID would be varied. For designing it, Alt.2 can appear to be more complicated in higher layer signaling perspective. |
| ZTE | We support Alt.2.From our perspective, some cons of Alt.1 are as following.1. Large overhead of MAC-CE, at least{32\*Z} bits are needed for this MAC-CE;2. Redesigning A-TRS triggering framework cause redundant specification;Regarding the four bullets of cons for Alt.2, we have the following comments:For bullet#1: We don’t think the current A-CSI triggering flexibility has any issue. We can also configure a separate triggering state list for efficient SCell activation.For bullet#2: The RRC signaling overhead may not be an issue, at least it is a one-time command. On the contrary, Alt.1 has high MAC-CE overhead and the MAC-CE may need to transmit occasionally. For bullet#3: We don’t think it is a con of Alt.2. In any case, we have also some other solutions to indicate the gap, e.g., explicit configuration.For bullet#4: These RRC parameters won’t cause much overhead from our perspective. |

### Issue-2: MAC-CE signaling for SCell activation/de-activation and temporary RS

Detailed signalling structure of the triggering MAC-CE(s) including the down-selection between the following example options and whether the decision should be made in RAN1 or RAN2, companies’ views are summarized as follows:

* Opt. 2.1: One new MAC CE for both SCell activation triggering and corresponding temporary RS triggering. [1][3][10]
* Opt. 2.2: One R15/16 SCell activation MAC CE for SCell activation triggering and one new MAC CE (in the same PDSCH) for corresponding temporary RS triggering [12]
* Opt. 2.3: Depend on RAN2’ decision. [5][8][11]

***FL Proposal****: For detailed signaling structure of the triggering MAC-CE(s) including the down-selection between the following options is left to RAN2 to decide:*

* *Opt. 1: One new MAC CE for both SCell activation triggering and corresponding temporary RS triggering*
* *Opt. 2: One R15/16 SCell activation MAC CE for SCell activation triggering and one new MAC CE (in the same PDSCH) for corresponding temporary RS triggering*

**Question 2: whether the above proposal is ok?**

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Xiaomi | We also think it should depend on RAN2’s decision on which direction is the final one. We support the proposal from FL. |
| Qualcomm | Considering the timeline for Rel-17 completion, we think it is better to make agreement in RAN1. Working assumption should be fine. The selection here impacts on both MAC-CE and RRC signalling. |
| Futurewei | We support the FL proposal but do not think it is absolutely necessary. |
| OPPO | We support FL proposal. This is anyway in RAN2 design scope.  |
| vivo | We are fine with this proposal. |
| LG Electronics | We prefer Opt.2. But, also OK to follow RAN2 decision |
| ZTE | We support Opt.1 and we are ok to leave it to RAN2. |

### Issue-3: Contents for the triggering signaling

**Issue 3-1: What contents should be indicated in MAC CE**

Multiple contents should be explicitly or implicitly indicated in new MAC CE. For example, the triggering offset of temporary RS can be either explicitly indicated in the new MAC CE or implicitly derived from a pre-configured list of RS resources and a RS resource ID indicated in the new MAC CE. **It would be very helpful for RAN2 signaling implementation if RAN1 could provide a list of contents that are recommended to be explicitly indicated by the new MAC CE.** Therefore, regarding what fields are explicitly indicated in MAC CE, companies’ views are summarized as follows:

* Opt 2.3.1: triggering information (e.g. trigger state ID/trigger RS ID) [1][15][16][17]
* Opt 2.3.2: Whether or not temporary RS is triggered [1][10]
* Opt 2.3.3: The number of RS bursts and the gap length between the RS bursts [17]
* Opt 2.3.4: Triggering offset of temporary RS [17]
* Opt 2.3.5: QCL information [17]

**Since this issue is coupled with the comparison between Alt 1 and Alt 2 in Sect 3.1.1, we may postpone this discussion until more outcomes from the other discussions, unless a majority of companies prefer to discuss this first.**

**Question 3.1: what fields are explicitly indicated in MAC CE?**

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Xiaomi | We are fine with FL’s guidance. From our perspective, only option 2.3.1 is needed for explicit indication. |
| Qualcomm | Opt 2.3.1. |
| Futurewei | We are open to 2.3.1, 2.3.2, 2.3.4 (for flexibility). We do not support 2.3.5. |
| OPPO | At least Opt 2.3.1. This proposal seems dependent on decision of Issue-1. If “A-TRS triggering framework” is selected for MAC-CE triggering framework or the decision for Issue-1 has to be left to RAN2, only Opt 2.3.1 is qualified. |
| vivo | We think at least Opt 2.3.1 and Opt 2.3.2 are needed. Opt 2.3.4 can be useful to address the issue of collision with uplink slot/symbols (i.e., Question G1), by providing some dynamic scheduling flexibility to avoid any collision. Then, no additional UE behavior should be specified. |
| LG Electronics | Opt 2.3.1 and Opt 2.3.2 are supposed to be considered first. The others and additional fields can be discussed later for MAC CE or RRC Signaling design. |
| ZTE | From our perspective, only the triggering state index (Opt 2.3.1) should be explicitly indicated in MAC-CE, all other information can be carried by RRC parameter. One example is as following. MAC-CE indicates the trigger state ID;RRC configures one TRS resource in the CSI-RS resource set;RRC configures the burst number;RRC configures the gap between the burst;All other information is the same as before, e.g., triggering offset. |

**Issue 3-2: Other issues**

Some issues for temporary RS configuration are proposed by some companies, it is appreciate for your views.

**Question 3.2:** If two temporary RS bursts are transmitted, both bursts employ the same temporary RS configuration, including time domain and frequency domain? Or two separate configuration for each temporary RS burst? [6]

|  |  |
| --- | --- |
| *Company* | *View* |
| Xiaomi | Our preference is the first solution, i.e. both bursts employ the same temporary RS configuration, including time domain and frequency domain. |
| Qualcomm | As per WA, the frequency-domain and time-domain structures should follow these for tracking RS. |
| Futurewei | We think this may be specified in RAN1 spec such as something like “if a second burst is configured/transmitted, it uses the same RS port and time/frequency domain parameters except for the slot offset”. Then the temporary RS configuration can be simplified. |
| OPPO | Both frequency domain and time domain structures are kept the same across two bursts. This is because:* The 1st burst may serve as AGC preparation for the 2nd burst, the two bursts are better to share the same frequency domain configuration in order to avoid frequency-selectivity difference.
* The same time-domain structure allows easy signal soft-combining in case the 1st burst is not used as AGC purpose.
* Different time/frequency patterns between the two bursts may increase the total number of configurations that are necessarily supported in Alt1/Alt2 under Issue-1.

Note that the two bursts having the same intra-burst structure (in both time domain and frequency domain) may share the same configuration, except the starting time-domain position of each burst: the starting time of first burst maybe configured by offset relative to transmission of MAC-CE, while the starting time of second burst maybe configured by gap between the two burst.  |
| vivo | We don’t see the need to have separate configurations for each temporary RS burst. |
| ZTE | From our perspective, we would prefer a simplified solution, i.e., both bursts employ the same temporary RS configuration, including time domain and frequency domain.We don’t see any strong motivation to have two separate configuration for each temporary RS burst. |
|  |  |

**Question 3.3:** Whether the N-bit for temporary RS ID can be omitted in the bitmap for deactivated SCell. [12]

|  |  |
| --- | --- |
| *Company* | *View* |
| Xiaomi | Yes |
| Qualcomm | We assume RAN4 would not require the use of of temporary RS for SCell deactivation procedure. With this, the answer should be yes. |
| Futurewei | Yes |
| OPPO | Yes, but having no N-bit of temp-RS ID does not mean to indicate the SCell is deactivated. BTW, is this bitmap in MAC-CE or RRC? We think it is in RRC because so far no agreement says temp-RS ID can be explicitly in MAC-CE.  |
| vivo | The question is a little unclear to me. Does it mean or propose to define a MAC CE having variable size, e.g., having different MAC CE size depending on the number of SCell being activated and/or deactivated? Or does it mean to reuse the legacy MAC CE to deactivate SCell?If the intention is to conclude that temporary RS ID is useful only at SCell activation, we can try this instead:Proposed conclusion:Temporary RS ID is only used for activation operation of SCell. |
| LG Electronics | We think it is natural and reasonable in terms of reducing signaling/resource overhead. There can be many information of Temporary on the above contents for to-be-activated SCells. The proposal we refer to can be helpful to reduce (unnecessary) overhead in MAC CE and by doing so, DL resource used to transmit PDSCH conveying the MAC CE can also be minimized. |
| ZTE | The UE behavior should be clarified first when the N bits are omitted. Otherwise, it is not clear why we need to discuss this issue. |

## Tactivation reduction

### Temporary-RS based

#### Issue-4: QCL configuration of temporary RS

In the previous meeting, a working assumption has achieved as follows:

|  |
| --- |
| **Working Assumption**For efficient SCell activation with assistance of temporary RS, a SSB of the to-be-activated SCell can be indicated as a QCL source for the temporary RS in case of known SCell* FFS: QCL type
* FFS: the case of unknown SCell
* FFS: other QCL source, e.g. the SSB/P-TRS of another active cell
 |

For the working assumption, 4 sub-issues are to be discussed, and corresponding companies’ views are summarized.

**Issue-4.1: whether the working assumption “For efficient SCell activation with assistance of temporary RS, a SSB of the to-be-activated SCell can be indicated as a QCL source for the temporary RS in case of known SCell” should be confirmed?**

* **Opt 4.1.1:** The P/SP TRS associated with the temporary AP TRS is the QCL source with Type A for the temporary AP TRS in case of known SCell, same as the legacy behavior. The temporary AP TRS and associated P/SP TRS jointly serve as the QCL source for other RS following it, same as the legacy behavior. [2]



* **Opt 4.1.2:** A-TRS can be a QCL source for SSB and CSI-RS to assist SSB detection and CSI measurement. Rel-15 QCL type for P-TRS and SSB/CSI-RS can be applied to QCL relation between A-TRS and SSB/CSI-RS. [6]
* **Opt 4.1.3:** Confirm. [1][11]

**Question 4.1-1: Whether the temporary RS can be QCL source for the operations after SCell activation? Whether it can be QCL source for the CSI-RS during the SCell activation, as the figure shown in Opt 4.1.1?**

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Xiaomi  | We are not clear on what is the benefit for expediting SCell activation if the temporary RS is used as the QCL source for the operations after SCell activation, comparing with legacy mechanism.The first question is whether it can speed up the SCell activation: if yes, we are open to discuss the possibility; if not, it would be out of scope. |
| Qualcomm | The WA should be confirmed. The rest can be same as legacy behavior. |
| Futurewei | Yes. Yes.Temporary RS should be the **temporary** QCL source for operations after SCell activation, at least before the UE can acquire SSB and P TRS. For operations in an activated cell, SSB and P TRS are the only QCL sources based on existing specs, but they cannot be always acquired during the new activation procedure. Therefore, the UE either has to wait for SSB and P TRS (which leads to long latency) or relies on the temporary RS. Note that relying on the temporary RS is to essentially rely on TRS, which leads to the same behavior for UE.@Xiaomi: this is to make sure properties/outcomes (e.g., tracking) acquired during the fast activation can be used afterwards. If we do not allow that, i.e., we speed up activation but cannot utilize the outcome of the activation, the fast activation becomes meaningless. |
| OPPO | Yes (while we are neutral to the QCL type shown in the figure). If SSB before SCell activation can be QCL source of A-TRS, we see no reason why A-TRS cannot be the QCL source for the SSB/CSI-RS sent after A-TRS, if the SSB/CSI-RS sent after A-TRS is by nature QCLed with SSB sent before SCell activation. In addition, for CSI-RS during Scell activation, because SSB and P-TRS maybe absent before CSI-RS, temporary RS as QCL source of CSI-RS is beneficial for CSI-RS measurement. |
| vivo | We can confirm the WA (opt 4.1.3). We are fine to reuse the tracking information after SCell activation.  |
| ZTE | To minimize the specification and implementation impact, our preference would be to contain this new UE behavior within SCell activation procedure. Thus, the temporary RS can NOT be QCL source for the operations after SCell activation. |
|  |  |

**Question 4.1-2: Whether the temporary RS can be QCL source for the CSI-RS during the SCell activation, as the figure shown in Opt 4.1.1?**

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Xiaomi | Same comments as above. Furthermore, this part is actually related to section 3.3. We don’t think it is necessary to introduce new QCL source before the justification of benefits. |
| Qualcomm | Tend to agree with Xiaomi. Actually, it is not clear what the difference from legacy behavior is. |
| Futurewei | Yes. Activation requires a CSI report, which requires CSI-RS reception, which has to be QCLed to a P TRS based on existing specs. Here we do not always have a P TRS, so we have to replace it with essentially the same signal, i.e., the temporary RS based on TRS. |
| OPPO | Yes. Same rational as from Futurewei.  |
| vivo | It should be clarified what the “CSI-RS” in the question is used for, e.g., is it for CSI measurement/reporting, or else? |
| ZTE | Regarding whether it can be QCL source for the CSI-RS during SCell activation, we also prefer to reuse the legacy UE behavior unless there is something broken. |
|  |  |

**Question 4.1-3: Whether the working assumption above can be confirmed?**

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Xiaomi | Yes |
| Qualcomm | Yes |
| Futurewei | Whether WA should be confirmed depends on the answers to the above questions. Overall, opt. 4.1.1 is the most natural solution. |
| OPPO | For the WA itself (aside from arguments relating to Opt 4.1.1 and Opt 4.1.2), the current wording of WA seems to say something differently from its intention. The current WA actually says that A QCL source for A-TRS can be indicated, which is subject to gNB behavior, in case SCell is known which is however an internal UE measure and kept unknown to gNB. In other words, the WA mentions a gNB behavior in case of a condition unknown to gNB. We think the better description is something like: ***For efficient SCell activation with assistance of temporary RS, if a SSB of a to-be-activated SCell is indicated as a QCL source for the temporary RS and the SCell is known, the UE can take the SSB as the QCL source, as indicated, for the temporary RS.*** |
| vivo | Yes |
| ZTE | Ok to confirm the working assumption. |
|  |  |

**Issue-4.2: if the working assumption is confirmed, which QCL types are expected?**

* **Opt 4.2.1:** 'typeC' with an SS/PBCH block and, when applicable, 'typeD' with the same SS/PBCH block. [1][3][5][7][17]

**Question 4.2: which QCL types are expected if the working assumption “For efficient SCell activation with assistance of temporary RS, a SSB of the to-be-activated SCell can be indicated as a QCL source for the temporary RS in case of known SCell” is confirmed?**

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Xiaomi | We are supportive to option 4.2.1 |
| Qualcomm | OK with option 4.2.1. |
| Futurewei | Whether WA should be confirmed depends on the answers to the above questions. Overall, opt. 4.1.1 is the most natural solution. |
| OPPO | OK with option 4.2.1. |
| vivo | Opt 4.2.1. |
| ZTE | OK with the Opt 4.2.1, which is the same as legacy UE behavior. |

**Issue-4.3: For the case of unknown SCell, whether SSB of one of the active cells can be indicated as a QCL source for temporary RS?**

* **Opt 4.3.1:** Yes, at least for intra-band CA. [3][17]
* **Opt 4.3.2:** Yes. [1][11]
* **Opt 4.3.2:** No

**Question 4.3: For the case of unknown SCell, whether SSB of one of the active cells can be indicated as a QCL source for temporary RS?**

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Xiaomi | Although we are OK with the intention of option 4.3.1 and 4.3.2, we think we should make the decision step by step to make sure it is workable. Hence we support option 4.3.1 at this stage. |
| Qualcomm | We think this is RAN4’s area since the following agreements have been made already in RAN4: **[R1-2102300]*** SCell is unknown and belongs to FR1
	+ When SCell is contiguous to an active serving cell in the same band (Intra-band continuous CA)
		- **1 burst (2-slot with four CSI-RS resources)** is necessary for AGC when the power difference in serving cell and to be activated Scell is smaller than or equal to 6dB
		- No cell detection provided the conditions specified for intra-band contiguous CA case in TS38.133 section 8.3.2 are satisfied;
		- **1 burst (2-slot with four CSI-RS resources)** is necessary for time-frequency tracking

**[R1-2106427]*** SCell is unknown and belongs to FR1
	+ When SCell to be activated is non-contiguous to an active serving cell in the same band, or
	+ When SCell to be activated and active serving cell are in the different band
		- **It is not a target scenario for temporary RS based SCell activation** latency optimization.
		- The agreement above applies based on RAN1 working assumptions on temporary RS design provided in the LS R1-2009798
* SCell to be activated belongs to FR2
	+ If the SCell being activated is unknown and there is no active serving cell on that FR2 band,
		- **It is not a target scenario for temporary RS based SCell activation** latency optimization.
		- The agreement above applies based on RAN1 working assumptions on temporary RS design provided in the LS R1-2009798
 |
| Futurewei | Yes, and support Opt 4.3.1 according to RAN4 inputs. |
| OPPO | Our choice is Opt 4.3.2 (No).RAN1 concluded that “RAN1 will not discuss for the case where a gNB may assume the to-be-activated SCell with assistance of temporary RS is a known SCell for a UE but it is actually unknown SCell from the UE side during the SCell activation duration”. The Opt 4.3.1 and Opt 4.3.2 need gNB to know the SCell is unknown in this case, which may not be ensured by current spec.  |
| vivo | Opt 4.3.1. |
| ZTE | This may need RAN4 expertise from our perspective. |

**Question 4.4: Whether the temporary RS can be used as a QCL source for any other RS or Channels?**

* **Opt 5.3.1:** Yes,
* **Opt 5.3.2:** No. [1][17]

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Xiaomi | We don’t see the motivation to use the temporary RS as a QCL source for other RS. |
| Qualcomm | We do not see the motivation to change the legacy behavior. |
| Futurewei | Opt 5.3.1, Yes and until SSB / P TRS are acquired.Other RS/channels are generally based on the following QCL chains:SSB – P TRS – DMRSSSB – P TRS – CSI-RSOther than SSB, other RS/channels need to have a QCL source, which shall be received earlier. In typical cases, temporary RS should be the QCL source during or right after activation. Otherwise, other RS/channels cannot be received before SSB is acquired or before SSB and P TRS are acquired. |
| OPPO | Our understanding is that the “other RS or channels” here does not include SSB and CSI-RS, which are discussed under Issue 4.1. With this understanding, we are ok with Opt 5.3.1 (Yes).  |
| vivo | The question is not clear on which specific RS or channel should be considered. |
| ZTE | No. From our perspective, to minimize the specification and implementation impact, the new UE behavior should be well contained within SCell activation procedure.  |

## TCSI\_reporting reduction

### Issue-5: Enhancement for CSI reporting

TCSI\_reporting reduction may be beneficial to achieve efficient SCell activation. Companies’ views are summarized as follows:

* **Opt 5.1** New MAC-CE command that triggers the SCell activation and A-TRS transmission is used to additionally trigger A-CSI-RS transmission. [13]
* **Opt 5.2** The new MAC CE introduced for temporary RS triggering can additionally indicate CSI reporting based on temporary RS for activated Scells [12]

*“CSI reporting based on temporary RS could be triggered simultaneously in the NEW MAC CE which will be introduced to trigger temporary RS of to-be-activated SCells. Since it is redundant to introduce additional MAC CE exclusively for CSI reporting based on temporary RS, it would be better to design so that temporary RS triggering and CSI reporting can be instructed simultaneously through the same MAC CE. Furthermore, it is worth to note that CSI reporting is not always triggered automatically when the MAC CE indicates temporary RS reception. So, through this MAC CE, temporary RS triggering and CSI reporting can be indicated separately. For example, both of temporary RS triggering and CSI reporting are indicated for some SCells, while only TRS triggering is indicated but CSI reporting is not indicated for other SCells.”*

* **Opt 5.3** The UE should consider the MAC-CE activation of a SCell as a trigger for a preconfigured SP-CSI reporting for that cell. [17]
* **Opt 5.4** short interval P/SP- CSI-RS report. [1]

“*The specific P/SP-CSI-RS/reporting for SCell activation can be received during the required period. This short interval P/SP-CSI-RS/reporting for fast SCell activation is beneficial with little specification impacts.*”

* **Opt 5.5** remove TCSI\_reporting for the case of FR2 unknown cell. [1]

“*During the procedure of SCell activation, when gNB receives the beam reporting, i.e. the L1-RSRP report, it implies that UE has completed beam selection and timing synchronization which are necessary conditions for downlink transmission. It means that gNB can start downlink transmission with a conservative or rough MCS on the SCell, and UE can start to monitor PDCCH on the SCell, even the valid CSI report is not yet reported. Thus the gNB and UE can assume the SCell is activated after the Tactivation\_time.*”

**Question 5: which options above of CSI reporting enhancement should be supported?**

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Xiaomi | From our perspective, we think option 5.1, 5.3 and 5.5 deserve further study. For option 5.1 and 5.3, we are no clear on how to determine the reference point and time offset for triggering A-CSI RS/SP CSI RS. We are open for further discussion if we can achieve a common understanding on which options can be further studied. |
| Qualcomm | Considering that only 2 WG meetings are left until December, we do not think it is reasonable to pursue another optimization of SCell activation. We should stick with completion of temporary RS based SCell activation procedure.Opt. 5.5 is purely RAN4 issue. |
| Futurewei | CSI enhancement should be supported to reduce the latency.It seems that Opt 5.3 can already be supported with explicit MAC CE activation:TS 38.133: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.For 5.1, we think a CSI-IM is also needed, making it a CSI reporting trigger. For the MAC CE signaling design, it can be discussed later. So we suggest to combine 5.1 and 5.2 as***Opt 5.1A*** *In the slot that a SCell activation command is sent, a MAC-CE command triggers A-CSI reporting.*We also support 5.4 and 5.5. |
| OPPO | Share the same view as from Qualcomm.  |
| vivo | We are open to consider Opt 5.5.We don’t think the need of others. |
| LG Electronics | We prefer Opt 5.2 for rapid PDSCH scheduling in to-be-activated SCell. In the respective of UE, Temporary RS can be the earliest RS for CSI measurement, the quick CSI reporting is possible with utilizing Temporary RS for CSI measurement. TCSI\_reporting can be efficiently reduced at the end. |
| ZTE | From our perspective, we propose to go with the legacy procedure. |

## General Issues

**Question G1:** For temporary RS, whether collision handling with uplink slot/symbols should be considered? [6]

Referring to [6], it was motivated by the following text in TS 38.214 “*If no two consecutive slots are indicated as downlink slots by tdd-UL-DL-ConfigurationCommon or tdd-UL-DL-ConfigDedicated, then the UE may be configured with one or more NZP CSI-RS set(s), where a NZP-CSI-RS-ResourceSet consists of two periodic NZP CSI-RS resources in one slot.*”

In [6], a proposal is “***Proposal 6****: Collision handling with uplink slot/symbol should be considered and the following potential solutions can be further discussed: scheduling restriction to avoid collision, cancellation and delay.*”

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Xiaomi | We think it is valid and crucial for TDD band considering the TDD UL DL configuration would be diverse. |
| Qualcomm | We are OK to discuss the issue G1. Basically, we think temporary RS can be configured and indicated such that the collision can be avoided. |
| Futurewei | Can the slot offset value be adjusted by the gNB to avoid collision? Or maybe the offset should always be interpreted as counting only DL slots. |
| OPPO | We think G1 needs to be discussed and solved. For suggestion from Futurewei to have offset counted in DL slot only, it is our understanding that this offset actually includes two offsets, including both the offset between MAC-CE and the 1st burst, and the gap between the two bursts; then at least the 2nd offset (i.e., the gap between the two bursts) should not be counted in DL slot only, because the minimum gap given by RAN4 does not differentiate DL slot and UL slot.  |
| vivo | We think it can be handled by network implementation. If necessary, triggering offset can be included in MAC CE to provide scheduling flexibility for it, as discussed in **Question 3.1**.In any case, no additional UE behavior is required to be specified. |
| ZTE | Based on our understanding, if the gap between bursts can be flexibly configured, then the issue mentioned by [6] can be addressed. |

## Other Issues

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

|  |  |
| --- | --- |
| *Company* | *View* |
|  |  |
|  |  |
|  |  |
|  |  |

# Conclusions

# References

1. R1-2108774 Discussion on efficient activation/de-activation mechanism for SCells Huawei, HiSilicon
2. [R1-2108797](file:///D%3A%5C2021%5CDocs%5CR1-2108797.zip) Support efficient activation/de-activation mechanism for Scells FUTUREWEI
3. [R1-2108856](file:///D%3A%5C2021%5CDocs%5CR1-2108856.zip) Discussion on Support Efficient Activation De-activation Mechanism for SCells in NR CA ZTE
4. [R1-2108930](file:///D%3A%5C2021%5CDocs%5CR1-2108930.zip) Discussion on efficient activationde-activation mechanism for SCells in NR CA Spreadtrum Communications
5. [R1-2109006](file:///D%3A%5C2021%5CDocs%5CR1-2109006.zip) Discussion on efficient activation/de-activation mechanism for Scells vivo
6. [R1-2109099](file:///D%3A%5C2021%5CDocs%5CR1-2109099.zip) Discussion on efficient activation/de-activation for Scell OPPO
7. [R1-2109391](file:///D%3A%5C2021%5CDocs%5CR1-2109391.zip) Discussion on efficient activation and de-activation mechanism for SCell in NR CA Xiaomi
8. [R1-2109519](file:///D%3A%5C2021%5CDocs%5CR1-2109519.zip) Remaining Issues on Scell Activation/Deactivation Samsung
9. [R1-2109637](file:///D%3A%5C2021%5CDocs%5CR1-2109637.zip) On efficient activation/de-activation for SCells Intel Corporation
10. [R1-2109705](file:///D%3A%5C2021%5CDocs%5CR1-2109705.zip) Discussion on efficient activation deactivation mechanism for Scells NTT DOCOMO, INC.
11. [R1-2109896](file:///D%3A%5C2021%5CDocs%5CR1-2109896.zip) Discussion on fast SCell activation/deactivation InterDigital, Inc.
12. [R1-2109988](file:///D%3A%5C2021%5CDocs%5CR1-2109988.zip) Discussion on fast and efficient SCell activation in NR CA LG Electronics
13. [R1-2110060](file:///D%3A%5C2021%5CDocs%5CR1-2110060.zip) On efficient SCell Activation/Deactivation Apple
14. [R1-2110129](file:///D%3A%5C2021%5CDocs%5CR1-2110129.zip) Efficient activation/deactivation of SCell ASUSTeK
15. [R1-2110142](file:///D%3A%5C2021%5CDocs%5CR1-2110142.zip) Reduced Latency SCell Activation Ericsson
16. [R1-2110214](file:///D%3A%5C2021%5CDocs%5CR1-2110214.zip) Efficient activation/de-activation mechanism for SCells in NR CA Qualcomm Incorporated
17. [R1-2110295](file:///D%3A%5C2021%5CDocs%5CR1-2110295.zip) On low latency Scell activation Nokia, Nokia Shanghai Bell
18. R1-2108674 Summary of email discussion [Post-106-e-Rel17-RRC-14] on efficient SCell activation/de-activation mechanism of NR CA, Moderator (Huawei)

# Appendix: Agreements

|  |
| --- |
| Agreements:As working assumption, with respect to efficient SCell activation, reuse existing Rel-15/16 TRS structure for temporary RS* FFS: how many burst/symbols are required for both AGC settling and Time/Frequency tracking for different cases, e.g. FR1 and FR2, known and unknown SCell
	+ A burst of temporary RS is notated as in S5.1.6.1.1 of TS 38.214
		- “2-slot with four CSI-RSs resources (4 samples)” for FR1
		- either “1-slot with two CSI-RSs resources (2 samples)” or “2-slot with four CSI-RSs resources (4 samples)” for FR2
* The working assumption can be confirmed after RAN4 check. (A LS for such request is planned).

Agreements:For efficient SCell activation, discuss and agree from the following alternatives at RAN1#104-e* Alt 1: the trigger of temporary RS is integrated into a single triggering signaling with the trigger of SCell activation transmitted on an activated cell.
	+ FFS detailed design of this integrated triggering signaling.
	+ Potential examples of single triggering signaling for further discussions
	+ A PDSCH TB, e.g. containing two respective MAC-CEs for both triggers, one MAC-CE for both triggers
	+ A DCI for both triggers
	+ A PDSCH TB and its scheduling DL grant, e.g. MAC-CE for activation and DL grant for temporary RS
	+ A DL grant and a UL grant received in the same slot/OFDM symbols of PDCCH where the DL grant is scheduling a MAC-CE for SCell activation and the UL grant is triggering the RS.
	+ Rel-15/16 SCell activation MAC-CE and a specific configuration of temporary RS being implicitly triggered as well
* Alt2: Triggering of temporary RS separately from SCell activation command is not precluded and both ‘separate’ triggers (examples below) and ‘integrated’ triggers (examples in Alt 1) are considered for SCell activation
	+ FFS detailed design of separate triggering signaling.
	+ Potential examples of separate triggering signaling for further discussions
	+ Rel-15/16 SCell activation MAC-CE and Rel 15/16 DCI triggering
	+ Rel-15/16 SCell activation MAC-CE and new DCI triggering for temporary RS
* Note: temporary RS should be triggered by DCI or MAC-CE.
* Note: the final mechanism of trigger signaling targets at applicability to one or more SCell activation.
* FFS handling of  SCell activation by existing Rel15/16 CA activation command when temporary RS is configured and triggered/not triggered

**Working Assumption**At least for the case of known cell, temporary RS is supported to expedite the activation process during the SCell activation procedure for efficient SCell activation for both FR1 and FR2:* The temporary RS should provide at least the functionalities of AGC settling and time/frequency tracking during SCell activation procedure.
* FFS potential functionalities of CSI measurement/acquisition and cell search

Agreements:TRS is selected as temporary RS for Scell activation         If more functionalities are confirmed to be supported by temporary RS, other RS candidates, e.g. aperiodic CSI-RS, P/SP-CSI RS, SRS and RS based on SSS/PSS, are not precluded.         The TRS should be triggered by DCI or MAC-CE. FFS which exact triggering command.  Agreements:UEs measure the triggered temporary RS during Scell activation procedure no earlier than a slot m:         FFS timeline values m which may need coordination with RAN4.         FFS if the triggered temporary RS can be associated with a BWP, then the measurement above is independent of the activation state of the BWP.Agreements:Companies are encouraged to provide design details of temporary RS next meeting, at least including:* TRS structure, e.g. whether to fully reuse existing Rel-15/16 TRS structure and configuration restriction (refer to S5.1.6.1.1 of TS 38.214), or any modification
* QCL information, if any
* Triggering command: DCI format/fields or MAC-CE fields
* Triggering timeline/scheduling offset

**Working Assumption**For efficient SCell activation with assistance of temporary RS, a SSB of the to-be-activated SCell can be indicated as a QCL source for the temporary RS in case of known SCell* FFS: QCL type
* FFS: the case of unknown SCell
* FFS: other QCL source, e.g. the SSB/P-TRS of another active cell

**Agreement**For efficient activation of SCells,down select at least one option from below:* Option 1a: MAC CE(s) contained in a single PDSCH to trigger both SCell activation and corresponding temporary RS(s)
	+ Details FFS including timeline design for receiving temporary RS
* Option 1b: A single DCI to trigger both SCell activation and corresponding temporary RS(s)
	+ Details FFS including potential impact on SCell activation related procedures and, e.g. timeline design for SCell activation and for receiving temporary RS
	+ FFS: The same DCI for SCell deactivation
* Option 2: A Rel-15/16 SCell activation MAC-CE to trigger SCell activation and a Rel-15/16 DCI to trigger corresponding temporary RS(s) with enhancement of timeline
	+ Details FFS including timeline design for receiving a DCI trigger of temporary RS, and for receiving temporary RS
* Note: Companies are encouraged to provide complete solutions for fast SCell activation.
* Note: the previous agreement on the definitions of Alt 1 and Alt 2 is still effective

**Agreement**For efficient activation of SCells* Option 1a: MAC CE(s) contained in a single PDSCH to trigger both SCell activation and corresponding temporary RS(s)
	+ Details FFS including timeline design for receiving temporary RS

Note: Separate from the support of Option 1a, it is up to RAN4 whether or not to consider an activation time enhancement for Option 2 without requiring further RAN1 work* Option 2: A Rel-15/16 SCell activation MAC-CE to trigger SCell activation and a Rel-15/16 DCI to trigger corresponding Rel-15/16 A-TRS(s)

Send an LS to RAN4. The LS is endorsed in R1-2104110.AgreementFor efficient activation of Scells, the triggered temporary RS is aperiodic.AgreementFor efficient activation of a Scell (in known Scell case), at least the number of temporary RS bursts is indicated by a field in new MAC-CE* The number of temporary RS bursts is RRC configurable.
* FFS: which field in MAC-CE is used and how this field is associated with the number of bursts
* For the purpose of designing temporary RS Scell activation, there is no RAN1 specification impact for the case where the number of indicated temporary RS bursts is smaller than what is expected by the UE

AgreementTo trigger temporary RS for efficient activation of SCells, the contents of the triggering MAC-CE(s) in a single PDSCH provide at least the following information (explicitly or implicitly):* Whether or not temporary RS is triggered
* FFS detailed Information of temporary RS, e.g.:
	+ Resources used for triggered Temporary RS
	+ Triggering time offset of triggered Temporary RS
	+ QCL source for triggered Temporary RS
* FFS: Detailed signalling structure of the triggering MAC-CE(s) including the down-selection between the following example options and whether the decision should be made in RAN1 or RAN2
	+ Opt. 1.1: One new MAC CE for both SCell activation triggering and corresponding temporary RS triggering
	+ Opt. 1.2: One R15/16 SCell activation MAC CE for SCell activation triggering and one new MAC CE (in the same PDSCH) for corresponding temporary RS triggering

AgreementFor efficient activation of a Scell (in known Scell case), the triggering offset of temporary RS is indicated by a field in new MAC-CE* The candidate value(s) of triggering offset(s) is RRC configurable
* FFS: which field in MAC-CE is used and how this field is associated with the value of triggering offset

AgreementFor the reference slot for triggering offset of temporary RS* Option 2: the last DL slot of the to-be-activated Scell overlapping with slot n+k as defined in 38.213 sub-clause 4.3
* FFS: the earliest slot no earlier than the reference slot for a UE to receive a triggered temporary RS

AgreementIf a UE measures a temporary RS triggered by a MAC-CE during SCell activation procedure, the measurement is performed within the BWP bandwidth of BWP indicated by *firstActiveDownlinkBWP-Id*Agreement For efficient SCell activation, the earliest slot for a UE to receive a triggered temporary RS is the reference slot (i.e., the last DL slot of the to-be-activated Scell overlapping with slot n+k as defined in 38.213 sub-clause 4.3).ConclusionFor the purpose of designing temporary RS for Scell activation, RAN1 will not discuss for the case where a gNB may assume the to-be-activated SCell with assistance of temporary RS is a known SCell for a UE but it is actually unknown SCell from the UE side during the SCell activation duration.AgreementFor to-be-activated SCell, if any BWP ID is configured as part of temporary RS(s) configuration, the value of the BWP ID is expected to be equal to *firstActiveDownlinkBWP*-Id;Agreement To trigger temporary RS, * MAC-CE at least provides the following information:
	+ temporary RSs are to be triggered on X out of Y (Y≥X) to-be-activated SCells, respectively, while no temporary RS is to be triggered on the other to-be-activated SCells.
* The following information can be provided by RRC for temporary RS for each SCell
	+ The number of RS bursts and the gap length between the RS bursts (Opt 2.3.3)
	+ Triggering offset of temporary RS (Opt 2.3.4)
		- ~~Triggering offset can be provided, e.g., by reusing existing CSI-RS framework~~
	+ QCL information (Opt 2.3.5)
		- ~~Triggering QCL information can be provided, e.g., by reusing existing CSI-RS framework~~
	+ ~~A unique temporary RS configuration index~~
	+ FFS: the maximum number of temporary RS per cell/per UE

Note: Reusing A-TRS triggering framework is not precluded.* Information for 0, 1, or more temporary RS can be provided for each configured SCell

Agreement* For triggering temporary RS, down-select based on the following alternatives, or let RAN2 be aware the status of this discussion
	+ Alt 1: Bitmap approach in MAC-CE ~~similar to SCell activation~~
		- Every Z-bit block in the bitmap corresponds to a SCell, Z>=0
		- A Z-bit block indicates the temporary RS [configuration index], and a value zero indicated by the bit block means no RS resource transmitted.
		- The to-be-activated SCell is indicated via the C values in the legacy SCell activation/de-activation MAC CE or in the new MAC-CE
	+ Alt 2: Reuse A-TRS triggering framework
		- A trigger state is indicated by the MAC-CE explicitly
		- The association between a trigger state and ~~aperiodic~~ temporary RS for one or multiple SCells is configured by RRC according Rel-16 A-TRS triggering framework
			* ~~SCell ID is configured as a part of the temporary RS configuration. Some SCell IDs derived from the trigger state triggered by the new MAC-CE may not refer to to-be-activated SCells that are indicated by the new MAC-CE or the legacy SCell activation/de-activation MAC-CE~~
		- FFS: The value zero of the MAC-CE indication means no temporary RS is triggered by the MAC-CE for all to-be-activated SCells
	+ Note: The down-selection targets at a RAN1 consensus on MAC-CE functionality and the list of RRC parameters for this feature. Any MAC-CE signaling design above are reference concept, its final MAC-CE signaling design is up to RAN2.
 |