**3GPP TSG RAN WG1 Meeting #105-e R1-21xxxx**

**e-Meeting,** **May 10th – 27th, 2021**

**Agenda Item: 8.13.3**

**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, three rounds with check points below are planned. This summary is for the first round and is expected to complete by May 24.

[105-e-NR-DSS-03] Email discussion/approval for efficient activation/de-activation mechanism – Frank (Huawei)

* 1st check point: May 24
* 2nd check point: May 27

According to the contribution papers under agenda item 8.13.3 for efficient activation/de-activation mechanism for NR CA SCells, and in light of the working assumption and agreements achieved the last meeting, 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 8 specific issues and 3 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:** Triggering signaling for SCell activation/de-activation and temporary RS
* **Issue-2:** Time-domain property of TRS
* **Issue-3:** Number of temporary RS bursts
* **Issue-4:** Triggering offset of temporary RS
* **Issue-5:** QCL configuration of temporary RS
* **Issue-6:** Associated BWP for temporary RS
* **Issue-7:** Tactivation reduction with BS assistance but no temporary RS nor SSB
* **Issue-8:** Enhancement for CSI reporting

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

* **Question G1:** Whether or not to additionally support AP CSI-RS, P/SP CSI-RS, SRS, and RS based on SSS/PSS as temporary RS, one or more of which may be used during SCell activation depends on network configuration / UE capability. [2]
* **Question G2:** If NACK is received for the PDSCH carrying the MAC-CE triggering a temporary RS, whether additional adjustment is necessary? [8]
* **Question G3:** Whether the existing Rel-16 A-CSI-RS/A-TRS triggering framework for temporary RS can be reused, or a new temporary RS trigger state list for SCell activation should be configured by higher layers? [8][21]

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 GTW session on May 24 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: May 24, and GTW session on May 24

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

* **Issue-1:** Triggering signaling for SCell activation/de-activation and temporary RS
* **Issue-2:** Time-domain property of TRS
* **Issue-3:** Number of temporary RS bursts
* **Issue-4:** Triggering offset of temporary RS
* **Issue-5:** QCL configuration of temporary RS
* For 2nd check point: May 27, 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.

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| *Company* | *View* |
| Qualcomm | OK with the suggestion, but please reflect our view captured in G3 into Issues 1 – 4. |
| Futurewei | We are generally fine with the suggestion. We think an additional discussion on the scenarios (based on RAN4 inputs) may be useful. * First, this will help us prioritize diverse scenarios and avoid different understandings on whether some (e.g., unknown cell) should be discussed or not.
* Second, this will help align RAN1 understanding on RAN4 inputs and their impacts on RAN1. Some RAN4 inputs may not have direct spec impact on RAN1. For example, some RAN4 inputs are based on RAN4 terms such as “fine timing tracking” which will not be captured in RAN1 specs but may need to be reflected in RAN1 specs. Therefore, RAN1 needs to “translate” RAN4 inputs into something that is fully and directly “compatible” / understandable / actable by RAN1.
* We suggest to further expand the table by the FL in 3.2.1.2 Issue-3 and reach a RAN1 agreement/conclusion on it. We suggest to discuss this for the 1st checkpoint.
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| ZTE | Ok with the prioritization. |
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# 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: Triggering signaling for SCell activation/de-activation and temporary RS

In the last meeting, many candidate options for triggering signalling of temporary RS and SCell activation are discussed, and finally converged to the option that MAC CE(s) contained in a single PDSCH to trigger both SCell activation and corresponding temporary RS(s). One or two MAC CE in the option should be further studied, companies’ views are summarized as follows:

Opt 1.1: One new MAC CE for both SCell activation triggering and corresponding temporary RS triggering. [2][3][20]

Opt 1.2: One R15/16 SCell activation MAC CE for SCell activation triggering and one new MAC CE for corresponding temporary RS triggering. [5]

Opt 1.3: One Rel-15/16 SCell activation MAC-CE for SCell activation triggering and implicitly trigger the corresponding temporary RS. [2][6][9]

Opt 1.4: Left to RNA2 design. [16][21]

Potential Cons and Pros for above options are summarized below.

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|  | Potential Cons | Potential Pros |
| Option 1.1 | * Considering that the existing SCell activation MAC CE can still work well for Rel-17 efficient activation, it seems undesirable to introduce a new MAC CE with (partial) **duplication functionality**….The RRC-based SCell activation has been supported in Rel-16, in which case the temporary RS can also be supported. An integrated MAC CE would be problematic in this case. [5]
* According to above analysis, gNB and UE does not have common understanding on whether a to-be-activated SCell is known or unknown. So gNB cannot always configure a precise A-TRS structure to match diverse to-be-activated SCell situation and **a conservative A-TRS structure is always applied**, then the flexibility of A-TRS structure is not necessary. [9]
 | * The new MAC-CE can be used to differentiate the Rel-17 fast SCell activation procedure from the legacy SCell activation procedure. With this, network and UE have the same understanding on the expected timeline. [4]
* UE behaviour is simpler, and UE which receives the new MAC CE just follows Rel-17 UE behavior, i.e., UE can use temporary RS based on the indication in the MAC CE. [20]
 |
| Option 1.2 | * The new MAC CE for temporary RS triggering may not be useful for scenarios other than SCell activation, so it may not be used without accompanying the SCell activation MAC CE. That is, the new MAC CE for temporary RS triggering should only be expected in a PDSCH also carrying the SCell activation MAC CE.[2]
* Usually it is an implementation issue to transmit two MAC-CE either jointly in one PDSCH or separately in two PDSCHs. gNB makes decision depending on available resource and system efficiency. Restriction on two MAC-CEs in one PDSCH may lead system efficiency loss. The decision on Option 3 should be made in RAN2, given the related spec impact happens in RAN2. [9]
* UE which receives the legacy MAC CE needs to check whether the new MAC CE for temporary RS is included or not in the same PDSCH, and then UE follows Rel-17 UE behaviour or legacy UE behaviour accordingly. [20]
 | * Considering that the existing SCell activation MAC CE can still work well for Rel-17 efficient activation, it seems undesirable to introduce a new MAC CE with (partial) duplication functionality. [5]
* The RRC-based SCell activation has been supported in Rel-16, in which case the temporary RS can also be supported. A separate MAC CE triggering temporary RS can be easily applied together with the RRC activation command. [5]
* Reuse the Rel-15/16 SCell activation MAC-CE. [6]
 |
| Option 1.3 | * Only one TRS can be implicitly triggered. [3][6]
* Flexibility is poor, e.g. gNB is hard to indicate temporary RS for some to-be-activated SCells but no temporary RS for some other SCells via one MAC-CE. [3]
 | * No additional signaling overhead to trigger the temporary RS. [3][5]
* Reuse the Rel-15/16 SCell activation MAC-CE. [6]
* No additional triggering mechanism for TRS. [6]
* Smallest spec impact. [9]
 |

The detailed signaling design of MAC-CE is up to RAN2, but it should be RAN1’s task to decide what contents in the signal are necessary. **Therefore, a list of potential fields for the signaling is provided below,**

For each SCell among multiple to-be-activated SCells,

* Whether a temporary RS is triggered or not
* Resource ID of the triggered Temporary RS
* Triggering time offset of Temporary RS (To be discussed in issue 4.2. Preconfigured offsets may limit the available downlink slots for MAC-CE of SCell activation, especially for TDD carriers with UL/DL configuration, which seems a new but unnecessary restriction for L2 signaling)
* Number of temporary RS burst (To be discussed in issues 3.1)

**Question 1: Which option above should be supported? What contents should be included in the MAC-CE? Your views on benefit/gain, specification impact, implementation complexity are encouraged.**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | Opt.1.1. |
| Futurewei | Opt. 1.3 can be the baseline with minimum standard impact.We are open to other options as additional / configurable features if benefit can be shown. |
| ZTE | We support Opt 1.1.A mechanism is needed to differentiate the legacy SCell activation timeline and the Rel-17 temporary RS based timeline. Opt 1.1 can be served for this purpose.Opt 1.2 still needs to define a new MAC-CE, the spec impact is similar as Opt 1.1.Opt 1.3 is too limited considering that we may need to trigger different TRS in different cases, e.g., TRS with different offset, beam, etc.Regarding the contents in the MAC-CE, at least we can confirm that the TRS triggering state should be put in it. The other contents may have dependency on the detailed solutions for different options. |
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## Tactivation reduction

### Temporary-RS based

#### Issue-2: Time-domain property of TRS

In the previous meeting, TRS is selected as the temporary RS. Some companies further analyze the triggering TRS type by MAC CE. Companies’ views are summarized as follows:

* **Opt 2.1** Aperiodic TRS [1][2][4][7][16][18][19]

***FL Proposal****: For efficient activation of SCells, the TRS triggered for temporary RS is aperiodic.*

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

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | Before agreeing this, we need to agree/confirm first whether the temporary RS is the legacy TRS.  |
| Futurewei | Support the proposal.For Qualcomm’s comment, we think the proposal wording can incorporate either case (regardless of legacy TRS or new TRS).But we are ok with rephrasing the proposal to address Qualcomm’s comment, such as *For efficient activation of SCells, the ~~TRS~~ triggered ~~for~~ temporary RS is aperiodic.* |
| ZTE | Ok with this proposal. |
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#### Issue-3: Number of temporary RS bursts

In RAN4 reply LS R4-2105799, there are some conclusions on the temporary RS for SCell activation.

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| FR1 | known | MC <= 160ms | 1 burst for AGC and T/F tracking |
| MC > 160ms | 1 burst for AGC, and separate 1 burst for T/F trackingGaps between RS symbols for AGC and T/F tracking:* Option 1: 2 slots
* Option 2: 2 ms
 |
| unknown | Intra-band continuous CA | 1 burst (4 samples) for AGC and 1 burst (4 samples) for T/F tracking |
| Other cases | TBD |
| FR2 | known | at least one active serving cell on that FR2 band | 1 burst (4 samples) can be used for T/F tracking |
| unknown |
| known | no active serving cell on that FR2 band | 1 burst (4 samples) can be used for T trackingFFS: number of symbols |
| unknown | no active serving cell on that FR2 band | Temporary RS cannot be used for AGC |

When the temporary RS can be used for efficient SCell activation, one or two temporary RS bursts are required and a gap between the RS symbol(s) for AGC and the RS symbols for time/frequency acquisition should be considered. RAN1 should take the reply into account, two sub issues should be discussed and companies’ views are summarized below.

**Issue-3.1: Indication of number of temporary RS bursts**

Opt 3.1.1: Configured within temporary RS configuration by RRC. [1][3][21]

Opt 3.1.2: Indicated in the MAC CE. [1][17][19]

Opt 3.1.3: Always 2 temporary RS bursts. [5][9]

Opt 3.1.4: No need to explicitly indicate according to RAN4 requirements. [4] (Quoted as below)

*“RAN4 will define corresponding requirements for Rel-17 fast SCell activation, network can repeat the TRS for a number of times as long as the requirements defined by RAN4 can be met. On the other side, UE can receive and measure the TRS for a particular number of times, it doesn’t need to measure all TRS as long as the requirements can be met by the UE.”*

**Question 3.1: Which option above should be selected with the RAN4 reply taken into account? Your views on benefit/gain, specification impact, implementation complexity are encouraged.**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | For each triggering state, a temporary RS that comprises one or two bursts with a gap is configured by RRC. Then, the triggering state is indicated by MAC-CE triggering signalling for the temporary RS to be transmitted. This is a combination of Opt.3.1.1 and Opt.3.1.2 and similar to legacy A-CSI-RS/A-TRS triggering via UL DCI. |
| Futurewei | We can be generally open to the options, but we want to emphasize that further clarification of RAN4 inputs is needed. For example, in the 3rd row in the FL’s table, it says “1 burst (4 samples) for AGC and 1 burst (4 samples) for T/F tracking”, but since the cell is unknown, based on RAN4 LS reply, cell detection may be needed if the conditions specified for intra-band contiguous CA case in TS38.133 section 8.3.2 are not satisfied. This may mean for some cases, 2 bursts for row 3 are insufficient, and a SSB may be needed. RAN1 needs to have a more complete picture on the numbers of TRS bursts / [SSB bursts] to make a good decision on this issue. Otherwise, RAN1 may be forced to revisit this issue even after reaching an agreement. |
| ZTE | Our current understanding is Opt 3.1.4. We would like to understand the necessity of indicating the number of bursts and what would be the consequence if gNB doesn’t indicate the number of bursts.If we indicate the number of bursts, it seems to imply that UE has to receive all the bursts. |
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**Issue-3.2: Gap between two temporary RS bursts**

Opt 3.2.1: Configured by RRC. [3]

Opt 3.2.1: Indicated in the MAC CE. [1]

**Question 3.2: Which option above should be selected if two temporary RS bursts are triggered? Your views on benefit/gain, specification impact, implementation complexity are encouraged.**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | For each triggering state, a temporary RS that comprises one or two bursts with a gap is configured by RRC. Then, the actually used triggering state is indicated by MAC-CE triggering signalling for the temporary RS to be transmitted. This is a combination of Opt.3.2.1 and Opt.3.2.2 and similar to legacy A-CSI-RS/A-TRS triggering via UL DCI. |
| Futurewei | As suggested above, we can be open but suggest to clarify RAN4 inputs first. |
| ZTE | We share similar view with Qualcomm for this issue.Regarding how to define/configure the gap via RRC, it is next-level detailed discussion. |
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#### Issue-4: Triggering offset of temporary RS

When temporary RS is triggered, the triggering offset between a reference slot and the slot in which the temporary RS is transmitted should be discussed. Two issues and corresponding companies’ views are summarized. Detailed restriction of triggering offset can be discussed as soon as this issue is completed.

**Issue 4.1: Reference slot for triggering offset of temporary RS**

Opt 4.1.1: The slot carrying HARQ-ACK information for the triggering MAC CE.[1][5][6][9][10][15][18][19][20][21]

Opt 4.1.2: The slot containing the MAC CE that triggers SCell activation and temporary RS. [3][8][17]

Opt 4.1.3: Last downlink slot on the to-be-activated cell overlaps with n+k defined in TS38.213. [2][7]

**Question 4.1: when considering the triggering offset of temporary RS, which reference slot is preferable?**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | As we presented in our contribution, using HARQ-ACK feedback timing as the reference for temporary RS triggering timing may cause scheduler complexity especially for the case of PDSCH re-transmission. However, from UE viewpoint there is less motivation to optimize the case. Hence we can live with Opt.4.1.1. |
| Futurewei | The options are not fundamentally different from each other, as they differ by pre-determined gaps. For example, the different between the ACK and slot n+k is a fixed 3 ms delay. In addition, we do not think any DL transmission can be reliably received by the UE before n+k, so n+k can be used as the reference. Then we suggest to stick with the existing RAN1 spec of n+k. |
| ZTE | As analyzed in our contribution, there are many other options for this issue, e.g., Opt 4.1.1+3ms. But we are ok with Opt 4.1.1. |
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**Issue-4.2: Indication of triggering offset**

Opt 4.2.1: Configured by RRC. [2][3][5][6][16][18][21]

Opt 4.2.2: Indicated in new MAC CE. [1][2][5][10][15][17][18][20]

Opt 4.2.3: Indicated by the PDCCH scheduling the PDSCH carrying the MAC CE. [10]

**Question 4.2: which option should be supported for triggering offset indication?**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | Same as A-CSI-RS triggered by a DCI, for each triggering state, offset value is configured by RRC. The MAC CE indicates a triggering state for the temporary RS to be transmitted. This is a combination of Opt.4.2.1 and Opt.4.2.2 and similar to legacy A-CSI-RS/A-TRS triggering via UL DCI. |
| Futurewei | Option 4.2.1 / 4.2.2. |
| ZTE | We share similar view as Qualcomm for this issue. The legacy triggering offset configuration can be reused. |
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#### Issue-5: QCL configuration of temporary RS

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

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| **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, 3 sub issues should be discussed, and corresponding companies’ views are summarized.

**Issue-5.1: 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 5.1.1:** Due to uncertainty of known SCell and unknown SCell, it is difficult for gNB to judge and then to indicate whether a SSB before SCell activation is a safe QCL source for A-TRS. [9]

“*As of Rel-16, known and unknown SCell are RAN4 internal terminologies; and gNB and UE may not have the same understanding whether a to-be-activated SCell is known or unknown.*”

* **Opt 5.1.2:** Confirm [3][7]

**Question 5.1: 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?**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | Yes |
| Futurewei | A better and more complete solution exists.The SSB and associated P/SP TRS of the to-be-activated SCell are the QCL source for the temporary AP TRS in case of known SCell, and the AP TRS serves as the QCL source for other RS following it, including P/SP TRS if sent after the AP TRS, and the AP/P/SP TRS serves as the QCL source for other RS after the P/SP TRS. For example, if the P/SP TRS is also available, QCL Type A between P/SP TRS and the temporary RS would be preferred over QCL Type C between SSB and the temporary RS. |
| ZTE | OK |
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**Issue-5.2: 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, which QCL types are expected?**

* **Opt 5.2.1:** 'typeC' with an SS/PBCH block and, when applicable, 'typeD' with the same SS/PBCH block. [3][4][5][7][16][19]

**Question 5.2: 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.

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| *Company* | *View* |
| Qualcomm | Yes |
| Futurewei | Fine with Type C, but a more complete solution covering all involved QCL relations is needed. For example, if the P/SP TRS is also available, QCL Type A between P/SP TRS and the temporary RS would be preferred. |
| ZTE | Opt 5.2.1, which is the same as legacy mechanism. |
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**Issue-5.3: For unknown SCell case, whether the SSB/P-TRS of another active cell** **can be indicated as a QCL source for the temporary RS?**

* **Opt 5.3.1:** Yes [3][7]
* **Opt 5.3.2:** No

**Question 5.3: For unknown SCell case, whether the SSB/P-TRS of another active cell** **can be indicated as a QCL source for the temporary RS?**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | We have not agreed to support unknown SCell case. We do not think we should agree this level of question. |
| Futurewei | We should follow RAN4 inputs. If AGC/cell detection/tracking rely on an activated serving cell in the same band, or rely on a contiguous activated serving cell in the same band, then yes. We also note that the cross-carrier QCL is bi-directional, i.e., if cell 1’s SSB can be a QCL source for cell 2’s temporary RS, cell 2’s SSB can also be a QCL source for cell 1’s temporary RS. So to configure/assume cross-carrier QCL, association between the SSBs for the carriers may be considered. That is, SSB 1 in cell 1 is QCLed with SSB 2 in cell 2, or vice versa. The UE does not really need to utilize one SSB to receive the other SSB, but the QCL relation is to inform the UE that cross-carrier QCL can be assumed. With the SSBs associated with each other, the other signals QCLed to SSB can be assumed to have implied QCL relationships with the cross-carrier SSB. |
| ZTE | This may need further RAN4 input. As indicated in the LS, RAN4 is still studying the unknown SCell case. |
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#### Issue-6: Associated BWP for temporary RS

All the BWP(s) configured on a cell are inactive before the cell is activated. If a UE measures the triggered temporary RS during SCell activation procedure, the measurement on the target BWP should be allowed despite of the activation state of the BWP. On which BWP the UE measures the temporary RS should be considered. Companies’ views are summarized as follows:

* **Opt 6.1** The BWP configured by “*firstActiveDownlinkBWP-Id”*. [5][9][15][16][18]
* **Opt 6.2** gNB indicates the BWP along with the indication of triggering the temporary RS. [7][19]

**Question 6: Which option listed above is preferable? Your views on benefit/gain, specification impact, implementation complexity are encouraged.**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | Opt.6.1 |
| Futurewei | We are fine with Opt 6.1 as the baseline.In addition, as a configured TRS is associated with a BWP ID, when a specific TRS is selected by the MAC CE (if supported), the BWP associated with the TRS is selected to be the active BWP |
| ZTE | We understand that Opt 6.1 is more aligned with the legacy mechanism and Opt 6.2 offers more flexibility for the network. We slightly prefer 6.2. |
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### The To-be-activated cell acquires essential information for activation enhancement from active cell

#### Issue-7: Tactivation reduction with BS assistance but no temporary RS nor SSB

It is proposed in [2][3] that activation time of the To-be-activated cell can be reduced by acquiring activation information (e.g. synchronization and AGC-related information, QCL information) from active cell(s) which are co-located with the To-be-activated cell. For example, the BS provides a UE the information of co-located reference active cells or source QCL cell to assist the activation of the To-be-activated cell, no SSB nor temporary RS is needed during the SCell activation procedure which can reduce the activation delay. The co-located SCells can be intra-band cells or adjacent inter-band cells.

**Question 7: Whether it is beneficial that neither SSB nor temporary is needed during SCell activation procedure, the AGC/time/frequency synchronization information derived from an activated cell?**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | As described in the table of Section 3.2.1.2 of this summary, RAN4 has already specified different latencies for different conditions including use of using other active serving cell in the same band. It is not clear what is actually considered in this proposal. We suggest to de-prioritize this discussion. |
| Futurewei | We can follow RAN4 inputs. |
| ZTE | It seems RAN4 is in the place to answer the question. If RAN4 confirms that it is beneficial, then RAN1 decides whether to support it and if yes, then RAN1 works on the potential RAN1 spec impact. |
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## TCSI\_reporting reduction

### Issue-8: Enhancement for CSI reporting

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

* **Opt 8.1** New MAC-CE command that triggers the SCell activation and A-TRS transmission is used to additionally trigger A-CSI-RS transmission. [15]
* **Opt 8.2** The temporary RS may be enhanced to support CSI measurement. [10]
* **Opt 8.3** short interval P/SP- CSI-RS report. [3]

“*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 8.4** remove TCSI\_reporting for the case of FR2 unknown cell. [3]

“*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 8: which options above of CSI reporting enhancement should be supported?**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | We do not think any of them should be discussed right now.  |
| Futurewei | We suggest to include AP CSI-RS triggering into the new activation framework. Unless RAN1/RAN4 can agree on Opt 8.4, SCell activation bottleneck may be the CSI acquisition / reporting in some cases. Further enhancements can be discussed. |
| ZTE | Currently, our understanding is that the legacy CSI reporting mechanism can be reused without any issue. This issue can be deprioritized and discussed later once if any issue has been figured out for the current mechanism. |
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## General Issues

**Question G1:** Whether or not to additionally support AP CSI-RS, P/SP CSI-RS, SRS, and RS based on SSS/PSS as temporary RS, one or more of which may be used during SCell activation depends on network configuration / UE capability. [2]

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | We do not think any of them should be discussed right now.  |
| Futurewei | We think it is quite beneficial to include more AP RS transmissions into the new SCell activation framework. Unless RAN1/RAN4 can agree on Opt 8.4, SCell activation bottleneck may be the UL / DL CSI acquisition / reporting in some cases. Further enhancements can be discussed. |
| ZTE | We can come back to this once we found any issue with the current TRS as temporary RS. |
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**Question G2:** If NACK is received for the PDSCH carrying the MAC-CE triggering a temporary RS, whether additional adjustment is necessary? [8]

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | This is a potential issue if we agree HARQ-ACK timing or MAC-CE timing as a reference timing to determine temporary RS transmission timing. As long as the reference timing is relative to the scheduler decision, the gNB has to take care of temporary RS trigger for the case of re-transmission. |
| Futurewei | This seems to be a gNB implementation issue; in general the gNB should just re-send and wait until an ACK to prepare for temporary RS transmission, which would be occur until 3 ms later at least according to existing specs. Not sure what needs to be done here.  |
| ZTE | Based on our understanding, the Rel-15/Rel-16 SP CSI reporting MAC-CE has the same issue. It can be left to the network implementation.  |
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**Question G3:** Whether the existing Rel-16 A-CSI-RS/A-TRS triggering framework for temporary RS can be reused, or a new temporary RS trigger state list for SCell activation should be configured by higher layers?[8][21]

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | The question does not reflect our input. Please reflect our view to Issue 1 – Issue 4.We propose to introduce a MAC-CE that has a trigger state field for each to-be-activated SCell. The trigger state field indicate one triggering state, where the triggering state is associated with a set of NZP-CSI-RS resource sets that comprises the temporary RS having one or two bursts. For each NZP-CSI-RS resource set, offset to identify the timing is configured. For each NZP-CSI-RS resources in the NZP-CSI-RS resource sets, TCI-state is configured. As such, the use of triggering state field is same as Rel-16 A-CSI-RS/A-TRS triggering framework.  |
| Futurewei | Open for discussion later. |
| ZTE | Agree with QC that this issue can be discussed together with Issue 1 – Issue 4. Based on understanding, either reusing the legacy trigger state list or defining a new state list is workable. Even if we define a new list, most of the configurations are the same as what we have right now. We are ok to define a list for this issue. |
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## Other Issues

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

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| *Company* | *View* |
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# Conclusions

# References

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8. [R1-2104699](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104699.zip) Efficient activation/de-activation mechanism for SCells in NR CA Qualcomm Incorporated
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12. Withdrawn
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# Appendix: Agreements

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| 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 searchAgreements: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. |