**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.
 |
| ZTE | Ok with the prioritization. |
| vivo | Fine with the plan. |
| CATT | Fine with FL’s suggestion. |
| InterDigital | We are ok with the suggestion. |
| Nokia | OK with the plan |
| Samsung | OK with the suggestions |
| NTT DOCOMO | Fine with FL’s suggestion |
| Apple  | Fine with the plan. On the other hand, we would like to emphasis that Issue 8 is important to make this fast SCell activation feature useful; Otherwise, the period of P-CSI-RS would become bottleneck step and limit the practical benefit of the whole feature.  |

# 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 RAN2 design. [16][21]

Potential Cons and Pros for above options are summarized below.

|  |  |  |
| --- | --- | --- |
|  | 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. |
| OPPO | Opt 1.3. For the argument of using Opt 1.1 to differentiate Rel-17 timeline from legacy SCell activation timeline, even if the gNB delivers an Opt 1.1 new MAC-CE, the UE may still go with the legacy timeline (following up SSB-based SCell activation) if the UE determines the cell is unknown and there is no active serving cell in the same band of to-be-activated SCell. This is confirmed by RAN4 reply LS at least for FR2. So such differentiation is pointless. For the listed potential MAC-CE fields:* Whether a temporary RS is triggered or not:
	+ We do not see a strong need to make this choice dynamically adaptive.
* Resource ID of the triggered Temporary RS:
	+ Same as above. The benefit of having dynamic adaptive resource for A-TRS is not justified.
* 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):
	+ There is certain existing logic to deal with this limitation, for example, with a pre-configured offset x, the A-TRS transmission starts in the earliest DL slot after n+x slot, where slot n is the slot for either sending triggering MAC-CE or sending HARQ-ACK for PDSCH carrying the MAC-CE.
	+ Because each A-TRS burst contains two consecutive DL slots, the interaction/restriction with TDD UL/DL configuration could anyway occur for any of the three signaling solutions.
* Number of temporary RS burst (To be discussed in issues 3.1)
	+ According to RAN4 reply LS, very likely the needed number of temporary RS bursts is determined on UE side and unknown to gNB (gNB only needs to ensure to transmit what UE needs, as a maximum safe bet). So this parameter should be made either static or semi-static based on certain stable conditions, and not be included in MAC-CE.

So in summary, no candidate in the given list of potential MAC-CE fields deems to have essential need to be carried by MAC-CE.  |
| vivo | We prefer Opt 1.2, but also OK to Opt 1.4. The contents of the MAC CE are dependent on the other issues (e.g., Issue 2, 3, 4, etc.).Regarding the comment/cons to Opt 1.2 that “the new MAC CE for temporary RS triggering should only be expected in a PDSCH also carrying the SCell activation MAC CE”, as discussed in our paper, this is incorrect *because it can be used if RRC-based SCell activation is performed*, in which case no SCell activation MAC CE is sent together.We have the following comments to other options, and hope that supporting companies can clarify:For Opt 1.1, we are not very clear how it works in the case of RRC-based SCell activation. For Opt 1.3, we are not sure whether it supports fallback to R15/16 SCell activation procedure, for example, in the case where no suitable resource can be used to send TRS. |
| CATT | Either Option 1-1 or Option 1-2 is OK to us given the most flexibility can be harvested. Which option is adopted in the end should depend on RAN2 decision. We should focus on what information related to TRS triggering is needed. |
| MTK | Opt.1.1. All the four potential fields for the signaling listed by FL can be provided in the new MAC-CE. Regarding RRC-based SCell activation, the dominant processing time would be the RRC message processing instead of Tactivation, and we tend to think focusing on MAC-CE based SCell activation is enough. |
| InterDigital | We prefer Opt. 1.1 |
| NEC | We prefer Opt 1.1. The contents of the MAC CE depend on the decisions taken for other relevant issues being discussed in this agenda item. |
| Intel | We prefer Opt 1.1, which is a cleaner solution. Opt 1.2 may require more discussions, e.g. whether the MAC CE triggering temporary RS and the MAC CE triggering SCell activation have to be in same PDSCH.  |
| Nokia | RAN1 is not in charge of MAC, and the design and organization of the MAC-CE is a RAN2 issue, not up to RAN1 to decide. i.e. Opt 1.4.RAN1 should focus on what information the MAC-CE needs to convey and what action that will trigger and convey this information to RAN2. |
| Ericsson | It may be better to first discuss what information about the temporary RS that is being triggered is configured by RRC and what (if any) information should be indicated via the new MAC/CE based mechanism (leave 1 vs 2 MAC CEs discussion to RAN2). Once this is clear, we can come back to discussing exact triggering mechanism. From our perspective, Opt 1.3 is quite inflexible and is not preferred (temporary RS has to be always triggered even when not needed which causes extra overhead, QCL information cannot be changed once configured which not suitable for beamforming based transmissions).Prefer to use A-CSI-RS trigger-state indication based approach.Contents-wise, at least the following information should be sent. (Both can be indicated by trigger state ID.)Whether/which A-TRS is triggered or notQCL source for a- TRS |
| Samsung | Option 1.4 (same reasons as Nokia).  |
| NTT DOCOMO | We prefer Opt 1.1 |
| Apple  | Our preference is Opt.1.1 due to the simplicity and clean solution merit. Regarding the concern on TRS for RRC-direct SCell activation, our understanding that it is independent SCell activation procedure and is NOT necessarily coupled with MAC-CE based signaling design. As one example, the required TRS can be directly configured as part of RRC-direct activation message without coupling with MAC-CE based approach. On Opt.1.1 vs. Opt.1.2, the benefit of Opt.1.2 is unclear for us as it unnecessarily complicates and consumes two LCIDs at least. On the other hand, the selection between Opt.1.1 and Opt.1.2 can also be left to RAN2 (i.e., Opt.1.4) as indicated by Nokia, if RAN1 cannot down select.  |
| Moderator | Based on latest companies’ feedbacks, more concerns are summarized below,Concern for Opt 1.1:* How it works in the case of RRC-based SCell activation

Concern for Opt 1.2* Benefit of Opt.1.2 is unclear for us as it unnecessarily complicates and consumes two LCIDs at least

Concern for Opt 1.3* Whether it supports fallback to R15/16 SCell activation procedure
* Temporary RS has to be always triggered even when not needed which causes extra overhead, QCL information cannot be changed once configured which not suitable for beamforming based transmissions

For the contents in MAC-CE(s), the majority views seem that at least triggering state of temporary RS for each to-be-activated SCell is needed.@vivo Regarding RRC based SCell activation (i.e. the concern for Opt 1.1), it is better to trigger temporary RS by RRC as well because the UE can start SCell activation once the RRC is received. If additional MAC-CE signaling has to be required, then the RRC based SCell activation has no benefit over MAC-CE based SCell activation.@OPPO It has been agreed that “• *Note: the final mechanism of trigger signaling targets at applicability to one or more SCell activation.*” In case of multi-Scell activation via a MAC-CE/PDSCH, it is more appropriate for a gNB to indicate no temporary RS for some SCells to a UE when there is no appropriate temporary RS resources for those SCells at that activation event. It is hard for the gNB to determine the availability of RS resources for multiple SCells in advance. In a certain slot, there may be available resource for some Scell, but no resource for the other Scells. So the triggering state of temporary RS is not appropriate to be preconfigured by RRC. @Ericsson, regarding reusing CSI-AperiodicTriggerState to indicate temporary RS, the CSI-AperiodicTriggerState is based on configuration of CSI report, but temporary RS does not require any dedicated CSI report, so the CSI-AperiodicTriggerState contains too many redundant signals. More importantly, it is not flexible enough to allow a gNB to trigger temporary RS for some of to-be-activated Scells while not trigger any for other to-be-activated SCells. If CSI-AperiodicTriggerState is reused, a gNB has to pre-configure a long list of CSI-AperiodicTriggerState to cover all possible combinations of SCells and trigger state of temporary RS. On the contrary, it is more flexible and lower overhead if the triggering state of temporary RS is directly indicated as a field of MAC-CE.  |
| vivo2 | Thanks Moderator providing answer to our question. I understand RRC based temporary RS triggering is one solution (maybe better solution) for RRC based SCell activation. But in this case, should RAN1 manage to design the RRC based triggering, or should it be handled by RAN2? |

#### FL proposal

With above summary, a potential proposal is,

***Proposal 1****: To trigger temporary RS for efficient activation of SCells,**the contents of the triggering MAC-CE(s) in a single PDSCH include at least:*

* *Triggering state of temporary RS for each to-be-activated SCell.*
* *FFS: Resource ID of the triggered Temporary RS*
* *FFS: Triggering time offset of Temporary RS*
* *FFS: QCL source for a- TRS*
* *Note: Up to RAN2 decision on detailed signaling structure of the triggering MAC-CE(s) including the down-selection between the following options*
	+ *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*

Comments are welcome.

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| --- | --- |
| *Company* | *View* |
| Futurewei | We’d like to address the concerns for Opt 1.3:* First, we suggested Opt. 1.3 as a baseline and it can be combined with other options. So if more flexibility is needed, the network can still signal other information about the temporary RS to the UE.
* Opt. 1.3 can support fallback activation procedure, and does not have to trigger temporary RS every time, IF the network does not configure a default temporary RS for activation. That is, with a default temporary RS configured for activation, the gNB/UE follow the new mechanism but otherwise they follow the legacy mechanism.
* This approach has probably the minimum standard impact and implementation impact to support temporary RS triggering. More flexible/complicated mechanisms can be optional/configurable based on UE/gNB implementation.

With the above replies, we hope Opt 1.3 can still be considered. We rephrased the proposal to incorporate this.Some other comments on the proposal:* The FFSs list some temporary RS parameters. We probably cannot make a complete/accurate list of the parameters. We suggest to change to “FFS: Detailed parameters for the triggered temporary RS”. Also these parameters may be in RRC and/or MAC, so we cannot say they have to be “included” in the MAC CE(s) contents. RAN1 should FFS which parameter(s) are included in the MAC-CE(s) and which are configured in RRC (as illustrated by FL’s Proposal 3).
* For the note, RAN1 may not want to limit RAN2’s design options. We suggest to change the wording as “example options” for RAN2.

Our suggested revised proposal:***Proposal 1****: To trigger temporary RS for efficient activation of SCells,**the contents of the triggering MAC-CE(s) in a single PDSCH provide information on at least:** *Temporary RS for a to-be-activated SCell.*
* *FFS: Detailed parameters for the triggered Temporary RS, e.g., triggering state, resource ID, triggering time offset*
* *FFS: Which parameter(s) are included in the MAC-CE(s) and which are configured in RRC*
* *Note: Up to RAN2 decision on detailed signaling structure of the triggering MAC-CE(s) including the following example options*
	+ *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*
 |
| CATT | We are supportive to the proposal.For the third FFS on QCL source, we are wondering why it is needed. QCL information is configured via RRC and nothing about MAC CE.  |
| vivo | We are fine with the proposal.@CATT Our understanding is that the QCL information is needed to activate a TCI state for the UE to monitor the TRS, similar to the existing TCI activation procedure.@Futurewei Regarding the fallback design for Opt 1.3, if I understand correctly, your solution is to enable fallback operation by explicit RRC reconfiguration, i.e., if the network does not want to trigger temporary RS (e.g., due to potential resource collision), the network should first reconfigure the temporary RS, and then start the SCell activation. I don’t think such a lengthy procedure is really useful for fallback. |
| ZTE  | We still have concern on the two MAC-CE solution. This will require higher RAN2 spec impacts, e.g., the association/relationship between the two MAC-CEs. Regarding for the RRC-based solution, we think it is a separate issue and can be discussed separately. In fact, RAN2 discussed similar issue for indication of the QCL info, companies discussed the RRC-based solution to indicate the QCL info. We can also use the RRC-based solution to indicate the TRS if necessary.Overall, Opt 1.1 is the preferred solution from our perspective. Regarding the proposal above, we didn’t see the necessities to list all the FFS here. Companies will keep debating the FFS here, which is not efficient. We suggest to delete all the FFS for now. |

## 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. |
| OPPO | Ok with the modified version from Futurewei.  |
| Vivo | OK with this proposal. |
| CATT | Support. |
| MTK | Support |
| InterDigital | We support the proposal. |
| NEC | Support the proposal |
| Intel  | Support |
| Nokia | Support the proposal, the “triggered temporary RS is aperiodic” as Futurewei wrote. |
| Ericsson | Same comment as Qualcomm |
| Samsung | Support the proposal. |
| NTT DOCOMO | Ok with this proposal. |
| Apple  | Support the proposal. Regarding Qualcomm’s comment, we agree it is important to discuss and conclude. On the other hand, whether it is legacy TRS or not seems a separate discussion point. |
| Moderator | The majority view seems ok with the Futurewei’s revision.@Qualcomm, Ericsson, Please elaborate your concerns a bit. If it is not aperiodic, do you suggest the triggered temporary RS should be effective even after the SCell is activated or something?*Proposal: For efficient activation of Scells, the ~~TRS~~ triggered ~~for~~ temporary RS is aperiodic.* |

##### FL proposal

With above summary, a potential proposal is,

***Proposal 2****: For efficient activation of Scells, the ~~TRS~~ triggered ~~for~~ temporary RS is aperiodic.*

Comments are welcome.

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| *Company* | *View* |
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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. |
| OPPO | Our preference is given below, and different from Opt 3.1.3: * For SCell activation in FR1: Always 2 temporary RS bursts.
* For SCell activation in FR2: Always 1 temporary RS bursts.

We wonder how Opt 3.1.1 and Opt 3.1.2 can work, given the number of temporary RS bursts that UE needs/requires is based on certain condition (known cell vs. unknown cell) that the gNB may not accurately/timely know. Opt 3.1.4 actually says the gNB can transmit certain temporary RS signal in certain slots (which are beyond what UE needs) without telling any UE about such excessive transmission. We doubt whether this can be a good practice in Uu interface specification.  |
| vivo | We think Opt 3.1.3 is the most simple and robust solution that can work in every case even if the network does not clearly know the MC and known/unknown status of the SCell of the UE.Regarding Opt 3.1.1/3.1.2, we agree that they can reduce RS overhead in some case, but the key concern is that the network and UE may not have aligned understanding on the SCell (i.e., known or unknown, MC length, etc.). |
| CATT | As gNB cannot recognize whether it is known/unkown to the UE, it cannot have a clear idea how many TRS bursts should be indicated. From this perspective, option 3.1.3 is reasonable.Furthermore, as summarized by the FL, only T/F tracking is mentioned in some scenarios while whether additional TRS burst for AGC settling is needed or not is unclear. It is critical for determining the number of TRS burst and should be clarified firstly. |
| MTK | Opt 3.1.2 or Opt 3.1.1 to leave the flexibility in case more bursts are needed for unknown cell case, which RAN4 has not replied. We also want to echo Futurewei’s comment on avoiding revisiting this issue. |
| NEC | We prefer option 3.1.2. As pointed out by MTK, it gives the flexibility to indicate greater than two bursts in case more bursts are required for the cases on which RAN4 has not replied yet. |
| Intel | We share Qualcomm’s view, i.e. a combination of Option 3.1.1 and 3.1.2 can be used. To be specific, there is not an explicit field indicating the number of bursts in Option 3.1.2. If gNB is too aggressive and does a wrong judgement on known/unknown and send only one Temporary RS burst to UE, UE may fail the fast SCell activation. However, such failure is under gNB control and happens with low rate.  |
| Nokia | We may need further RAN4 input before the final decision can be taken, but for now it looks like the RRC configuration (the measurement cycle) will determine if 1 or 2 bursts should be triggered. This is perhaps what is meant with 3.1.4, but we understood this to be 3.1.1 as it is related to RRC config.The core question to ask is that do we need to explicitly provide the UE with the # of bursts and if so, is it sufficient to provide this in the RRC, or is MAC-CE something that is needed.  |
| Ericsson | Option 3.1.1 and 3.1.2. We do not prefer Opt 3.1.3 as it unnecessarily increases overhead. |
| Samsung | Option 3.1.4. Also OK with not optimizing SCell activation/deactivation for use-cases requiring 2 temporary RS bursts as they do not represent relevant scenarios for enhancements of SCell activation/deactivation. |
| NTT DOCOMO | Option 3.1.1 + Option 3.1.2. We share Qualcomm’s view. |
| Apple  | We think more discussions are needed before down selection of options.The main motivation of Opt.3.1.3 seems the possible misalignment on known vs. unknow state of SCell between gNB and UE. RAN1 needs to discuss and conclude whether it is common understanding or not. If it is confirmed, one interpretation e.g., Intel, is that the UE is allowed to fallback to legacy SCell activation procedure based on SSB with larger latency. In other words, the tighter timing requirement would not be required for UE in this mis-alignment case. Our view is that RAN1 should make conclusion/agreement on this and let RAN4 know; Otherwise, UE maybe mandated to meet the tighter timing requirement for fast SCell activation even the misalignment situation happens between gNB and UE. If all the pending points above are clear up and UE is allowed to fallback to SSB-based legacy procedure for misalignment case, we share views from Qualcomm and Intel that ‘Opt.3.1.1 + Opt.3.1.2’ provides the best flexibility and very similar as the legacy DCI-based approach.  |
| Moderator | Concerns:* Potential misalignment between gNB and UE on the known/unknown state of a SCell at the UE. The gNB may have to take a conservative strategy on the number of bursts of temporary RS. (OPPO, vivo, CATT
* Higher overhead for always sending max number of bursts (Ericsson)
* 2 bursts may not be sufficient. For some unknown cases, more bursts of temporary RS and even SSB burst may be needed which is still under discussion in RAN4. (Futurewei)
* Alternatively, Opt 3.1.1 and Opt 3.1.2 can be combined together so that the number of bursts is RRC configurable in a list.

We can go with the combination of Opt 3.1.1 and Opt 3.1.2, but some detailed signaling can be FFS at this stage. |

##### FL proposal

With above summary, a potential proposal is,

***Proposal 3****: For efficient activation of a Scell, the number of temporary RS bursts is implicitly indicated by a field in new MAC-CE*

* *The number of temporary RS bursts is RRC configurable.*
* *The field of new MAC-CE is associated with an entity of a configured list where every entity can have different value of the number of temporary RS bursts*
* *FFS: the exact associated field in the MAC-CE, e.g. the triggering state ID of temporary RS*

Comments are welcome.

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| --- | --- |
| *Company* | *View* |
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**Issue-3.2: Gap between two temporary RS bursts**

Opt 3.2.1: Configured by RRC. [3]

Opt 3.2.2: 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.

|  |  |
| --- | --- |
| *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. |
| OPPO | Based on preliminary information from RAN4, a gap or minimum of the gap by RRC configuration should be sufficient. But let’s wait for RAN4’s final decision on the gap.  |
| vivo | We prefer Opt 3.2.1, considering the flexibility especially in the case of dynamic TDD operation, where the gap may need to be adaptive to the SFI. |
| CATT | Same view as Qualcomm. |
| MTK | We think using RRC configuration is enough. |
| NEC | We prefer to wait for RAN4’s final decision on the gap. |
| Intel | Same view as Qualcomm. |
| Nokia | Same view as Qualcomm. |
| Ericsson | Prefer to wait for RAN4 input |
| Samsung | Wait for RAN4 input.  |
| NTT DOCOMO | Same view as Qualcomm. |
| Apple  | Same view as Qualcomm |
| Moderator | Thank you for the feedbacks.9 companies prefer RRC configuration or RRC-dependent methods. 5 companies prefer to wait for more RAN4 inputs on the gap. According to the discussions, the outcome seems to only impact on RRC, so **let’s suspend the discussion** till more RAN4 inputs are received and concrete designs are done.  |

#### 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. |
| OPPO | 4.1.1.  |
| vivo | Opt 4.1.1 |
| CATT | We also support option 4.1.1.But as we mentioned in our contribution, the slot carried HARQ-ACK is defined with reference of UL slot. It needs to translate to downlink slot as the TRS is transmitted by gNB. Accordingly, it should be updated as below:Opt 4.1.1: The last downlink slot overlaps with the slot carrying HARQ-ACK information for the triggering MAC CE. |
| MTK | Opt 4.1.2. This is the most straightforward reference slot. |
| InterDigital | Option 4.1.1 |
| NEC | Opt 4.1.1. |
| Intel | Opt 4.1.1 |
| Nokia | We are suggesting 4.1.2, because as long as what the gNB does is send MAC-CE + TRS, then the possible additional overhead of perhaps 10% of the time sending unnecessary TRS is diminished by the simplicity and the potentially reduced timeline. With this there is no ambiguity between the UL and DL slots either, something that has been causing quite some grief in both Rel-15 and Rel-16 maintenance. |
| Ericsson | We prefer Option 4.1.3, (which seems to be similar to Futurewei suggestion). Indeed using 4.1.1 leads to additional scheduler restrictions and may need new triggering offset value range (since offsets that lead to < 3ms are unused). This can be avoided by just aligning to existing RAN1 spec of n+k. |
| Samsung | The slot after the SCell is activated as defined by the Rel-16 timeline for the MAC CE. The HARQ-ACK timeline can result to TRS transmission prior to SCell activation. |
| NTT DOCOMO | Ok with Opt 4.1.1 |
| Apple  | Opt.4.1.1 |
| Moderator | The majority of companies prefers Opt 4.1.1.Two companies prefer 4.1.2, thinking it is more straightforward.Two companies prefer 4.1.3, reusing the RAN1 spec of n+k as reference.CATT suggested to clarify a bit the Opt 4.1.1 that it is the last DL slot overlapping with the UL slot of HARQ-ACK. It is helpful for the case with different numerology. Considering TA for the UL slot, it seems better to clarify further that it is the nominal DL slot overlapping with the UL slot.Since there is no fundamental difference, we could go with the majority view.@Ericsson, **could you please elaborate a bit** the additional scheduler restriction that you concerned? |

##### FL proposal

With above summary, a potential proposal is,

***Proposal 4-1****: For efficient activation of a Scell, the reference slot for triggering offset of temporary RS is the last nominal DL slot of the to-be-activated SCell overlapping with the UL slot ca*

*rrying HARQ-ACK information for the triggering MAC CE.*

Comments are welcome.

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| *Company* | *View* |
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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.

|  |  |
| --- | --- |
| *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. |
| OPPO | The total offset (from MAC-CE to temporary RS) can contain two delays: * The delay from triggering MAC-CE to its corresponding HARQ-ACK is given by PDCCH scheduling the PDSCH carrying the MAC-CE;
* The delay from HARQ-ACK to temporary RS transmission is configured by RRC.

It should be noted that these two delays may be counted based on different SCS – the 1st delay may be based on SCS in the serving cell where UE receives activation MAC-CE, and the 2nd delay may be based on SCS in the to-be-activated SCell.  |
| vivo | Opt 4.2.2 (1st preference), Opt 4.2.1 (2nd preference) |
| CATT | Same view as Qualcomm, Option 4.2.1 + Opition 4.2.2 |
| MTK | Opt 4.2.2.  |
| InterDigital | Combination of Opt. 4.2.1 and Opt. 4.2.2 |
| NEC | Opt 4.2.2. |
| Intel | Opt 4.2.2. |
| Nokia | Combo of 4.2.1 and 4.2.2, i.e. agree with Qualcomm et al. |
| Ericsson | Opt 4.2.1 |
| Samsung | Opt 4.2.1 – offset value is configured by RRC. The triggering state maps to an RRC-configured offset. |
| NTT DOCOMO | Opt 4.2.1 + Opt 4.2.2. Same view as Qualcomm. |
| Apple  | Combination of Opt.4.2.1 and Opt.4.2.2.  |
| Moderator | The majority of companies (7 companies) prefers to a combination of Opt 4.1.1and Opt 4.2.22 companies for Opt 4.2.14 companies for Opt 4.2.2 |

##### FL proposal

With above summary, a potential proposal is,

***Proposal 4-2****: For efficient activation of Scells, the triggering offset of temporary RS is implicitly indicated by a field in new MAC-CE*

* *The value of triggering offset is RRC configurable*
* *The field of new MAC-CE is associated with an entity of a configured list where every entity can have different value of triggering offset*
* *FFS: the exact associated field in the MAC-CE, e.g. the triggering state ID of temporary RS*

Comments are welcome.

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| *Company* | *View* |
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#### Issue-5: 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, 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.

|  |  |
| --- | --- |
| *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 |
| OPPO | The WA reads as “something can be indicated [from gNB to UE] in case of known SCell”, which describes a gNB behavior of “indication” conditioned upon a status on UE side. But the gNB actually cannot ensure whether the SCell is known to UE because some RAN4 conditions not reported to gNB could turn the SCell into unknown status for the UE. We see some inconsistency between this WA and RAN4 spec, and therefore do not support confirming the WA. This WA is not a must-have for fast SCell activation.  |
| vivo | OK |
| CATT | Yes |
| MTK | No. Same concern as OPPO, how does gNB know whether the SCell is known to UE or not? |
| InterDigital | Confirm |
| Intel | OK to confirm the WA |
| Nokia | Yes |
| Ericsson | Keep the WA |
| Samsung | OK in principle but ACK to the comments by OPPO and MTK that “known SCell” needs to be described from a RAN1 perspective. Can revisit after defining what a “known SCell” is and how the gNB and the UE can have same understanding. |
| NTT DOCOMO | Ok |
| Apple  | Yes |
| Moderator | Main concern:* Potential misalignment between gNB and UE on the known/unknown state of a SCell at the UE. The gNB may have to take a conservative strategy on the number of bursts of temporary RS.

Companies are encouraged to share more views to address this concern. |
| vivo | Our view to this misalignment issue is same as that for the number of temporary RS bursts. Due to the potential misalignment, the gNB triggers the temporary RS with two bursts. Similarly, the gNB can anyway indicates the assistant SSB, and the UE can decide whether to make use of it according to the actual known/unknown state. |

**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.

|  |  |
| --- | --- |
| *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. |
| vivo | Opt 5.2.1 |
| CATT | Yes |
| NEC | Opt 5.2.1 |
| Intel | Yes |
| Nokia | Opt 5.2.1  |
| Ericsson | As described in Opt 5.2.1 |
| Samsung | Opt 5.2.1 |
| NTT DOCOMO | Opt 5.2.1 |
| Apple | Opt 5.2.1 |
| Moderator | Consensus seems achieved.One company suggests to cover the other cases, e.g. QCL between P/SP TRS and the temporary RS. Companies’ comments on this are welcome. |
| vivo | We would like to first understand what the issue is for the case, e.g., P-TRS. Isn’t the Rel-15/16 QCL still workable for determining QCL for P-TRS?  |

##### FL proposal

With above summary, a potential proposal is,

***Proposal 5****: For efficient activation of a Scell, if a SSB of the to-be-activated SCell is indicated as a QCL source for the temporary RS in case of known SCell, the QCL type is expected to be*

* *‘typeC' with an SS/PBCH block and, when applicable, 'typeD' with the same SS/PBCH block*

Comments are welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| vivo | Our view to this misalignment issue is same as that for the number of temporary RS bursts. Due to the potential misalignment, the gNB triggers the temporary RS with two bursts. Similarly, the gNB can anyway indicates the assistant SSB, and the UE can decide whether to make use of it according to the actual known/unknown state.We would like to first understand what the issue is for the case, e.g., P-TRS. Isn’t the Rel-15/16 QCL still workable for determining QCL for P-TRS?  |
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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.

|  |  |
| --- | --- |
| *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. |
| OPPO | Need further RAN4 input. The current RAN4 message is that, even with the existence of an active serving cell in the same band, RAN4 still assumes temporary RS of at least one burst is needed on the to-be-activated cell for time/frequency tracking. RAN4 provides no hint showing that even the time/frequency tracking functionality can also be moved from to-be-activated cell to active-serving-cell.  |
| vivo | Wait for RAN4’s responses before answering this question. |
| CATT | Yes. For the unknown cell, RAN4 already announce the feasibility if some conditions are met, e.g. there is an active cell for intra-band continuous CA. At least for the available scenarios for unknown cell, SSB on another active cell can be considered as the QCL source for the temporary RS. |
| MTK | Yes. Same view as Futurewei/CATT. |
| Intel | Need further RAN4 input. |
| Nokia | Wait for RAN4 |
| Ericsson | Similar view as Qualcomm |
| Samsung | Wait for RAN4 – also relates to issue/question 5.1 |
| NTT DOCOMO | Wait for RAN4 |
| Apple  | Wait for RAN4 |
| Moderator | The majority of companies prefers to wait for more RAN4 inputs. Let’s suspend this discussion. |

#### 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] [7]
* **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.

|  |  |
| --- | --- |
| *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. |
| OPPO | Opt 6.1. It seems possible that, even if the gNB wants the UE to work on Rel-17 SCell activation, the UE may still decide to follow legacy SCell activation (the known vs. unknown SCell could be one of reasons). Therefore it is beneficial to maintain the legacy UE behavior on this BWP determination to avoid the potential BWP mis-match between gNB and UE.  |
| vivo | Opt 6.1.Regarding Opt 6.2, we would like to be clarified, does it propose to change the SCell activation behavior as well (e.g., the first activated BWP is no longer the one with *firstActiveDownlinkBWP-Id*)? If not, what is the motivation of Opt 6.2? |
| CATT | Our position has already been updated in our document. We are also fine with Option 6.1. |
| MTK | Opt 6.1 |
| InterDigital | Option 6.1. |
| NEC | Option 6.2 offers flexibility to the network. We are also fine with Opt 6.1. |
| Intel | Opt 6.1 |
| Nokia | 6.2 could be beneficial, but we are OK with 6.1 as well |
| Ericsson | Opt 6.1 |
| Samsung | Option 6.1 – that is the purpose of *firstActiveDownlinkBWP-Id*  |
| NTT DOCOMO | Opt 6.2 can provide gNB flexibility. We are also fine with Opt 6.1. |
| Apple | Opt. 6.1 |

### 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.

|  |  |
| --- | --- |
| *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. |
| OPPO | The RAN4 reply LS seems already say NO. The current RAN4 message is that, even with the existence of an active serving cell in the same band, RAN4 still assumes temporary RS of at least one burst is needed on the to-be-activated cell for time/frequency tracking. RAN4 provides no hint showing that even the time/frequency tracking functionality can also be moved from to-be-activated cell to active-serving-cell. From RAN1 perspective, the SCell activation based on RS from an active serving cell is a 3rd solution besides the legacy SSB-based activation and Rel-17 A-TRS based activation. We do not see a strong need for RAN1 to seek the 3rd solution before completing what is already agreed to handle in Rel-17.  |
| vivo | Wait for RAN4’s input before answering this question. |
| MTK | We are not able to link this proposal to current RAN4 reply. More discussion is needed. |
| Intel | Wait for RAN4’s input |
| Samsung | Wait for RAN4 and deprioritize. |
| NTT DOCOMO | Wait for RAN4’s input. |
| Apple  | Prefer to wait for RAN4 further Input.  |
|  |  |
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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.

|  |  |
| --- | --- |
| *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. |
| OPPO | Share the same views from Qualcomm and ZTE. This topic should be deprioritized.  |
| vivo | None. We don’t think it is necessary to discuss this issue currently. |
| CATT | It may be helpful if the valid CSI reporting can only associated with periodic CSI-RS. We are open to discuss the motivation and the detail solution. |
| MTK | We tend to think legacy CSI reporting mechanism can be reused. We are open to discuss more about Opt 8.3/8.4. |
| Intel | We think CSI report should be available ASAP in fast SCell activation. We are open for potential solutions |
| Nokia | We support investigating these mechanisms. |
| Samsung | No need to enhance CSI reporting – any delay reduction has an overall marginal impact to the SCell activation. This is meant to be less complex to operate than using dormancy/non-dormancy. |
| NTT DOCOMO | It can be deprioritized unless any issue is found. |
| Apple | Opt.8.1. Opt.8.3 is also ok for us but seems it causes larger overhead if a P-CSI-RS with a smaller period is always configured for this purpose. In general, we are open for any solutions to reduce CSI reporting latency. As commented at the start, it is important to reduce CSI reporting by introducing aperiodic CSI-RS as part of fast SCell activation framework; Otherwise, CSI report would become bottleneck and make the whole feature less attractive.  |

## 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. |
| OPPO | No, unless A-TRS alone is proved to be problematic and adding more types of RS does not make the problem even bigger or generate new problems.  |
| vivo | Currently we don’t think any strong motivation for this. |
| CATT | It can be deprioritized. We think the current mechanism with introducing temporary RS is sufficient. |
| MTK | Yes. We think RS based on SSS/PSS as temporary RS is beneficial for unknown SCell activation since cell detection is needed.  |
| Intel | Agree to deprioritize it in the moment |
| Nokia | The context of this is somewhat unclear, e.g. if PSS/SSS are transmitted as part of normal SSB broadcast, they are there and can be used, but are not part of Temporary RS. If we are talking of in addition to the TRS, also transmitting some other aperiodic signal, the motivation is missing. Transmitting SRS as additional TRS seems the most puzzling. We don’t quite understand the direction of this |
| Samsung | Deprioritize |
| NTT DOCOMO | It can be deprioritized unless any issue is found. |
| Apple  | We support A-CSI-RS to reduce the CSI reporting latency.  |
| Moderator | No enough support. This discussion is deprioritized. |

**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.  |
| OPPO | The question is asked for gNB behavior. Then it is gNB implementation issue, as other companies suggested.  |
| vivo | This question is highly dependent on other issues, such as Issue 3, Issue 4, etc. Generally, we think network implementation can handle this. |
| CATT | We share the same issue that it can be up to gNB implementation. If NACK is received, the MAC-CE can be re-transmitted by the gNB. |
| MTK | We also think this is up to gNB implementation. |
| NEC | This is a gNB implementation issue. |
| Intel | Prefer to up to gNB implementation to handle it |
| Nokia | Not an issue. A NACK means the UE did not receive anything, if the gNB anyway sends the TRS, then that is overhead that the UE doesn’t know about. The UE can only act on a correctly received MAC-CE and if that is a reference for the operation then only correctly received MAC-CE can act as a reference. The spec would be written from the receiver perspective and the incorrectly received MAC-CE does not exist in the specs, gNB handles it the way it sees fit. |
| Samsung | gNB can handle as for any NACK (whether or not a MAC CE is involved) |
| NTT DOCOMO | We also think it is up to gNB implementation. |
| Apple  | Share views from ZTE and the situation exists already in Rel-15/16 and nothing is concluded/specified for it. Same handling should be used here i.e., left for gNB implementation.  |
| Moderator | In majority view, it is up to gNB implementation. Let’s close this discussion. |

**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. |
| vivo | It is highly dependent on the outcome of Issue 1-4. |
| MTK | Same view as ZTE. |
| Nokia | Agree that this is not an independent issue and should be resolved when the design is outlined in more detail |
| Samsung | Agree with Nokia |
| Apple  | We support Qualcomm’s proposal.  |
| Moderator | The issue can be discussed under issue#1 - #4. This discussion here is closed. |

## 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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3. [R1-2104234](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104234.zip) Discussion on efficient activation/de-activation mechanism for SCells Huawei, HiSilicon
4. [R1-2104342](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104342.zip) Discussion on Support Efficient Activation De-activation Mechanism for SCells in NR CA ZTE
5. [R1-2104393](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104393.zip) Discussion on efficient activation/de-activation mechanism for Scells vivo
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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
9. [R1-2104808](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104808.zip) Discussion on efficient activation/de-activation for Scell OPPO
10. [R1-2104933](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104933.zip) On efficient activation/de-activation for SCells Intel Corporation
11. R1-2104989 On efficient activation/de-activation for SCells Intel Corporation
12. Withdrawn
13. R1-2105046 On efficient activation/de-activation for SCells Intel Corporation
14. Withdrawn
15. [R1-2105133](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105133.zip) On efficient SCell Activation/Deactivation Apple
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20. [R1-2105725](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105725.zip) Discussion on efficient activation deactivation mechanism for Scells NTT DOCOMO, INC.
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22. [R1-2105846](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105846.zip) Efficient activation/deactivation of SCell ASUSTeK

# 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. |