**3GPP TSG RAN WG1 Meeting #104-e R1-210xxxx**

**E-meeting, January 25 –February 05, 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 Jan/27.

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

* 1st check point: Jan 27
* 2nd check point: Feb 1
* 3rd check point: Feb 5

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 7 specific issues and 7 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 command for SCell activation/de-activation and temporary RS
* **Issue-2:** Time-domain property of TRS
* **Issue-3:** QCL configuration of TRS
* **Issue-4:** Timeline for temporary RS and SCell activation
* **Issue-5:** Associated BWP for temporary RS
* **Issue-6:** Tactivation reduction with BS assistance but no temporary RS nor SSB
* **Issue-7:** Enhancement for CSI reporting

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

* **Question G1:** Whether or not temporary RS should be introduced for unknown cells?
* **Question G2:** Whether or not temporary RS should be introduced for both FR1 and FR2 case?
* **Question G3:** 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.
* **Question G4:** Whether or not support additional functionality of temporary RS during SCell activation, e.g. CSI measurement/acquisition, cell search.
* **Question G5:** Whether RAN1 need to clarify whether to support A-TRS for RRC-based SCell activation.
* **Question G6:** For cases where Rel15/16 TRS structure is re-used for ‘temporary RS’, whether there is need to define a separate ‘temporary RS’ configuration in addition to already existing TRS configuration.
* **Question G7:** whether aperiodic TRS is decoupled with periodic TRS related to the time-domain pattern if aperiodic TRS is served as temporary RS.

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 Thursday 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: 1/27, and GTW session on Thursday

Note: The following issues have impacts on details of TRS

* **Issue-1:** Triggering command for SCell activation/de-activation and temporary RS
* **Issue-2:** Time-domain property of TRS
* **Issue-3:** QCL configuration of TRS
* For 2nd check point: 2/01, and potential new GTW session
* **Follow-ups for all issues listed in 1st check point**
* **The remaining issues with potential consensus**
* 3rd check point: 2/05
* **Wrap-up for all 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 | No objection to the suggestions on the schedule. |
| ZTE | For the three issues listed for 1st check point, from our perspective, Issue-2 has high dependency on RAN4 input. For example, if RAN4 confirms that 1 or 2 slots of TRS is sufficient, then aperiodic TRS is preferred. If RAN4 confirms that more slots of TRS are needed, then maybe periodic TRS is more suitable. Thus, we suggest to focus on Issue-1 and Issue-3 only. |
| Nokia | OK with the suggested schedule, but RAN1 should wait for the RAN4 response on RAN1’s LS out in [R1-2009798](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_103-e/LS/Outgoing/R1-2009798.zip) on TRS time-domain properties before proceeding further in RAN. |
| vivo | Fine with the schedule. |
| Futurewei | Support |
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# Discussions

In current specifications, when a UE receives a SCell activation command in a PDSCH in slot , the UE shall complete SCell activation no earlier than and no later than slot *n*+ [*THARQ* + *Tactivation\_time* + *TCSI\_Reporting*]/ 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 2, more detailed comments are welcome.



Figure 1 SCell activation procedure

## THARQ reduction

### Issue-1: Triggering command for SCell activation/de-activation and temporary RS

In the last meeting, some candidates for the trigger of temporary RS and SCell activation are agreed. Combining new alternatives proposed in this meeting, all the candidates and companies’ views are summarized as follows:

* 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 [2]
  + Alt 1.1: A PDSCH TB, e.g. containing two respective MAC-CEs for both triggers, one MAC-CE for both triggers [6][10][13][15]
    - Alt 1.1.1: A PDSCH TB containing two respective MAC-CEs for both triggers
    - Alt 1.1.2: A PDSCH TB containing one new MAC-CE for both triggers [9]
  + Alt 1.2: A DCI for both triggers [7][10]
    - Alt 1.2.1: An existing AP CSI-RS trigger [1]
    - Alt 1.2.2: An existing AP SRS trigger [1]
    - Alt 1.2.3: An existing AP TRS trigger [1]
    - Alt 1.2.4: A single UL DCI format 0\_1 or 0\_2 [11]
    - Alt 1.2.5: group-common DCI [12]
    - Alt 1.2.6: at least DCI format 0\_1/1\_1/2\_6 [18]
  + Alt 1.3: A PDSCH TB and its scheduling DL grant, e.g. MAC-CE for activation and DL grant for temporary RS [5][10][13]
  + Alt 1.4: 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.
  + Alt 1.5: Rel-15/16 SCell activation MAC-CE and a specific configuration of temporary RS being implicitly triggered as well [1][3][4][6][8]
  + Alt 1.6: New MAC CE for SCell activation and temporary RS triggering as well as A-CSI-RS transmission [14]
* 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
  + Alt 2.1: Rel-15/16 SCell activation MAC-CE and Rel 15/16 DCI triggering [5]
    - Alt 2.1.1: No NW restriction on slot n+m1 receiving trigger of temporary RS where n is the slot carrying the SCell activation command; [16]
    - Alt 2.1.2: NW restriction on slot n+m1 receiving trigger of temporary RS where n is the slot carrying the SCell activation command, and m1 is no earlier than [k1 + 3ms + 1]; [15]
  + Alt 2.2: Rel-15/16 SCell activation MAC-CE and new DCI triggering for temporary RS [16]

Summary of main concerns:

For Alt1,

* Additional spec impact for new MAC CE/DCI of triggering
* Unclear main benefit over reusing the legacy triggerings.

For Alt2,

* Additional spec impact to define a valid window to receive DCI trigger of A-TRS after the DCI scheduling SCell activation command is received. (Beyond the window, such DCI trigger is not effective for SCell activation.)
* Lack of integrity of triggering commands and its resulting false alarm of either one triggering.
* In case of simultaneous activation of multiple SCells, the size of CSI-AperiodicTriggerStateList used to A-TRS triggering may be too limited to accommodate all different combinations of SCells, or more frequent RRC updates of CSI-AperiodicTriggerStateList may be required.

**Question 1-1: Whether the trigger of temporary RS is integrated into a single triggering signaling with the trigger of SCell activation transmitted on an activated cell, i.e. Alt 1 or Alt 2 is selected?**

Taking into the main concerns of both sides, companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | Alt.2 (Alt.2.1.2)  Alt.2 can support at least some of the scenarios with minimum (almost zero) spec impact. With the separate signalling, one of them might be errored with a certain probability, but this does not cause critical issue. Hence, RAN1 should agree to support Alt.2.1.2 firstly. Then Alt.1.1.1 and Alt.1.1.2 can be discussed/considered. |
| OPPO | Support Alt 1 (Alt 1.5).  For Alt2, our main concern is that the independent confirmations for separate triggering may lead to missing one of the two triggering:   * If such missing is known to both gNB and UE, additional spec impacts should be in place to define the UE behavior whether UE should go further with SCell activation or TRS reception in case the other triggering is not received. We guess whether additional timer should be defined in RAN2 spec for this. * If such missing is not sync-up between gNB and UE, another set of protocol logic needs to apply, which is very-likely in RAN2 protocol stack. Then more coordinations between two WGs are needed. |
| ZTE | Support Alt.1 (Alt 1.1 or Alt 1.2.6)  As we can see in the current TS 38.133, similar as TCI indication, there are lots of different timelines for different locations of TCI indication for FR2 SCells. If separate indication is adopted for SCell activation and temporary RS, RAN4 may need to define more timelines depending on different locations of these separate indications.  Note, there are too many different alternatives here. Maybe we can first down-select some of them and then further study/compare different solutions. |
| CATT | Technically speaking, either way, i.e. integrated triggering or separate triggering, can work. In order to support the two functionalities, i.e. Scell activation and temporary RS triggering, separate bit fields are needed.  Currently, the situation is very divergent as there are many options under the umbrella of each scheme. For sake of progress, maybe we can try to make some down selection within each bunch of options. It can provide cleared picture on what we are pursuing and facilitate the discussion on which way we should go with finally. |
| Nokia, NSB | Our main motivation for single trigger is the logical simplicity of triggering a procedure with a single trigger rather than splitting it to two separate triggers. DCI trigger would latency-wise be most attractive, but the flexibility of the DCI design is limited and its ability to scale to multiple cells is poor.  If our primary design goal would be to minimize spec impact, we would propose MAC CE for activation and DCI for triggering, but we haven’t seen the new MAC-CE design to be of significant issue.  Hence we have a clear preference for using a MAC CE for both activation and triggering.  One concern in using MAC-CE also for triggering is the linkage of an L2 procedure to L1 timing, but as this is something we have been doing elsewhere, the L2-to-L1 timing linkage needs to be possible already. |
| vivo | Alt-1.  Alt-2 cannot be supported for free – there are some issues to be resolved once this mechanism is introduced. Firstly, it complicates the processing timeline design as discussed, because the triggering DCI and the SCell activation command may not be received at the same time. Such kind of uncertainty would complicate the design and increase workload of specification and testing. Moreover, the existing DCI triggering only triggers a single TRS burst, which may only be used for either AGC settling or time/frequency tracking, but not both. Consequently, during SCell activation two TRS triggering DCIs are required, which further complicates the design. |
| Ericsson | Alt 2  The main advantage of Alt 2 is it allows reuse of existing Rel15/16 triggers (i.e., SCell activation command MAC CE and DCI based TRS trigger) and avoids the complexity of Alt1.  The disadvantage of Alt 1 is it forces NW/UE to support new triggers even to receive the reference signals that are already supported in Rel15/16 (i.e., TRS) and also forces the unnecessary NW timeline restrictions (i.e., forces the gNB to always decide whether or not to trigger a A-TRS with SCell activation at least 3-4ms in advance of the slot(s) with A-TRS transmission (longer in case of retransmissions).  Then on some of the above comments….  a) “*…complicates the processing timeline design*…”   * UE/NW already support Rel15/16 SCell activation where the timing of RS reception (i.e., SSB or P-TRS) is not fixed compared to activation MAC CE reception. Then UE anyway has to support such SCell activation via SSB/P-TRS reception even in Rel17 (e.g. in scenarios where NW does not trigger ‘temporary RS’, or when operating in legacy NW). So, UE can simply reuse same procedures without any additional complexity. * On the contrary, forced integrated triggering (Alt. 1) places timing restrictions on NW and complicates processing timeline on the NW side.   b) “…. *separate triggering may lead to missing one of the two triggering ….If such missing is not sync-up between gNB and UE, another set of protocol logic needs to apply, which is very-likely in RAN2 protocol stack*”   * L1 triggering of CSI-RS and TRS has been operational since Rel15 and rare error cases (<1% probability), of missing L1 signaling have marginal impact on performance. This is especially true for SCell activation case, where handling of such error cases does not provide sufficient motivation for introduction of new triggering mechanisms (i.e., on rare occasions of missed A-TRS trigger, UE can still use SSB, P-TRS for SCell activation with Rel16 SCell activation delay). * On “*another set of protocol logic needs to apply, which is very-likely in RAN2*”, it should be noted that timeline of how UE acquires sync/AGC for SCell is left to UE implementation (there are no UE procedures defined for this in RAN1 spec). There is no need to change this approach for either Alt 1 or Alt 2.   c) “…*ability to scale to multiple cells is poor*…”, our understanding is existing SCell activation MAC CE and CSI-RS triggering can trigger activation and TRS respectively on multiple cells. So, at least as a baseline the existing triggering should be supported as also indicated by Qualcomm. Then if need for some more flexible triggering is identified, we are open to enhancements being discussed as part of Alt 1. |
| Futurewei | Alt 1, in particular Alt 1.2 and Alt 1.5. We suggest to down select at high level first.  If TRS is always going to be triggered during activation, one joint trigger is sufficient and the rest can be left for procedural enhancement.  For Alt 2, as the temporary RS is likely to be just a reused existing RS, the temporary RS can be triggered in R15/16 way already during the activation. Then we are not very sure what RAN1 needs to do here --- by implementation the gNB can already send the MAC activation command followed by one or more AP RS triggers. There may be a lot of work for RAN4, though. |
| Intel | Alt 1.2.  Alt 2 is not preferred since UE may not received of the two triggers which requires additional handling to align the understandings of gNB and UE. Alt 1.2 is preferred than other alternatives under Alt 1 is due to its lowest latency. |

**Question 1-2: if Alt 1 is preferred, which triggering command for SCell activation/de-activation is preferable?**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | FFS between Alt.1.1.1 and Alt.1.1.2 after agreeing Alt.2.1.2  RAN1 should support Alt.2.1.2 firstly. Then Alt.1.1.1 and Alt.1.1.2 should be discussed/considered. |
| OPPO | Alt 1.5.  For Alt 1.1.1 and Alt 1.1.2, we do not think RAN1 needs to differentiate between these two alternatives. It seems purely RAN2 signaling choice.  For Alt 1.2, we feel the functionality does not sufficiently deserve the cost in defining a new DCI. In addition, moving the SCell activation triggering from MAC-CE to DCI may introduce new reliability discussion in RAN1 as well as the protocol re-design in RAN2 (RAN2 needs to add DCI-based cell activation and makes it work with MC-CE based and RRC-based activations/deactivations in the same piece of protocol).  For Alt 1.3, we do not see the functional difference between Alt 1.3 and Alt 1.1.2/Alt 1.5, because what they say is that the TRS is triggered by MAC-CE (Alt 1.1.2) or something uniquely corresponding to that MAC-CE (Alt 1.3/Alt 1.5). Meanwhile, Alt 1.3 may still partially suffer the issue that the reception of PDSCH can separately succeed or fail upon a good DCI reception, which is somehow the problem in Alt 2.  For Alt 1.6, we understand this is actually Alt 1.1.1 with additional interpretation for CSI.  Between Alt 1.1.x and Alt 1.5, Alt 1.5 is preferred due to less spec impact. We are also open to let RAN2 decide among Alt 1.1.x and Alt 1.5. |
| ZTE | We prefer Alt 1.1 and Alt 1.2.6.  If Alt.1.1 is selected, then we can leave the detailed MAC-CE design to RAN2.  For Alt.1.2.6, the current SCell dormancy indication field may be reused to minimize the specification impact. |
| CATT | Alt 1-3 and alt 1-4 are preferred. |
| Nokia, NSB | Alt 1.1.2. |
| vivo | Alt-1.1/1.5/1.6.  At this stage, we don’t have to differentiate 1.1.x, 1.5 and 1.6. They all rely on the MAC CE to trigger the temporary RS. Whether the temporary RS can be used for CSI reporting is a separate issue, and once it is agreed, we can further discuss whether the same trigger is reused.  Considering that Alt-1 is preferred to avoid the timeline uncertainty issue, then Alt-1.3 and Alt-1.4 is not favorable as they cannot resolve the timeline issue.  Alt-1.2 requires significantly increased physical layer overhead if a new DCI field is introduced to an existing DL or UL grant (as SCell activation is not a frequent operation), or lots of design efforts if a new DCI format is introduced. Given that the existing MAC CE based SCell activation works well, this complicity does not justify. |
| Ericsson | As also suggested by QC, RAN1 should support Alt.2 first (either 2.1.1 or 2.1.2 is OK). Then among the sub-alternatives being discussed for Alt1, 1.1.1, 1.1.2 and “TRS triggering via DL DCI that also schedules Rel15/16 MAC CE” (not clear if this is listed above) can be considered further. We do not believe Alt 1.5 is suitable for NR - with that option the TRS location has to be fixed wrt. SCell activation command and adaptation of TRS beam is not possible |
| Futurewei | Alt 1.2 with existing DCI triggers and Alt 1.3. |
| Intel | We prefer Alt 1.2 in general. Existing trigger 1.2.3, 1.2.1 is preferred if they are sufficient for the operation. Otherwise, 1.2.6 can be considered |

**Question 1-3: if Alt 2 is preferred, which triggering command for SCell activation/de-activation is preferable?**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | Alt.2.1.2  RAN1 should support Alt.2.1.2 firstly. Then Alt.1.1.1 and Alt.1.1.2 should be discussed/considered. |
| CATT | Alt 2.1.1 is preferred |
| Nokia, NSB | Alt 2.1.1 |
| Ericsson | OK with either 2.1.1 or 2.1.2. We do not see 2.1.2 providing a big restriction as NW may anyway prefer to trigger TRS after n+k1+3ms (i.e., after UE has processed the MAC CE) |
| Futurewei | We do not see the need for new DCI for temporary RS, so we can first remove Alt 2.2. Alt 2.1.1 may be the same as the legacy design. So Alt 2.1.2 is the only choice. But as discussed, we do not support Alt 2. |
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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 TRS type, including periodic TRS, aperiodic TRS and semi-persistent TRS. Companies’ views are summarized as follows:

* **Opt 2.1** Aperiodic TRS [6][8][13][14][15]
* **Opt 2.2** Periodic TRS [15]
* **Opt 2.3** Semi-persistent TRS [6]

**Question 2: Which TRS above should be selected as the temporary RS? Your views on benefit/gain, specification impact, implementation complexity are encouraged.**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | Opt.2.1 and Opt.2.2. |
| OPPO | Comparing to what TRS type should be used (from UE configuration perspective or from gNB transmission perspective), we think it is more important to decide/check first the TRS signal structure that can be used in one-time SCell activation. Our contribution in R1-2100188 shows one issue of using legacy TRS without repetition: for an 2% of chance under SNR of -6dB, the synchronization/tracking error can be as large as 1/4 of symbol duration (far larger than CP), which causes incompatibility with RAN4 MRTD requirements. It also conflicts with RAN1 baseline results in Coverage Enhancement SI for SSB reception, which needs to achieve 1% BLER around -9dB ~ -12dB. |
| ZTE | From our perspective, this issue is highly dependent on RAN4’s input. For example, if RAN4 confirms that 1 or 2 slots of TRS is sufficient, then aperiodic TRS is preferred. If RAN4 confirms that more slots of TRS are needed, then maybe periodic TRS is more suitable. |
| CATT | **Opt 2.1.** Aperiodic TRS is naturally suitable for fast SCell activation, which can be triggered on demand.  There are some restrictions on the periodicity of Periodic TRS, e.g. the periodicity should be equal or larger than 10 ms. In order to reduce the activation delay, a small periodicity is needed for the periodic TRS. The overhead goes up eventually.  For semi-persistent TRS, it may be better from overhead point of view compared to P-TRS. However, it is triggered by MAC CE which will introduce additional delay. |
| Nokia, NSB | Opt.2.1 and Opt.2.2. |
| vivo | Opt 2.1 or Opt 2.3  Opt 2.2 is not preferred, as the delay of SCell activation could be reduced only when the periodicity of the TRS is short, i.e., 10ms (the smallest in Rel-16), or an even smaller number is desirable for fast activation. However, this will cause significant network overhead. |
| Ericsson | Opt 2.1 (2.2 is already supported in Rel15?) |
| Futurewei | Opt 2.1 is definitely required. If the QCL is needed or the link is to be kept alive for efficient activation, long-periodicity P/SP TRS should also be considered. |
| Intel | Assuming one-shot detection is supported, we slightly prefer Opt 2.1 |

#### Issue-3: QCL configuration of TRS

In current specification, aperiodic TRS should be QCLed with a periodic TRS and the periodic TRS can be QCLed with an SSB. During the SCell activation, for the QCL configuration of TRS, three sub-issues can be discussed, and corresponding companies’ views are summarized.

Issue-3.1: if aperiodic TRS is selected as temporary RS, whether a periodic TRS should be sent first as a QCL source for the temporary RS (aperiodic TRS based)?

* **Opt 3.1.1:** No [2][4][6][11]

**Question 3.1: if aperiodic TRS is selected as temporary RS, whether a periodic TRS should be sent first as a QCL source for the temporary RS (aperiodic TRS based)?**

Companies’ views are very welcome.

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| *Company* | *View* |
| Huawei, HiSilicon | No, if additional periodic TRS has to be sent first as a QCL source, then the periodic TRS can be used as temporary RS for SCell activation which makes the subsequent aperiodic TRS is redundant. Therefore, it is straightforward not to require such periodic TRS as a QCL source. |
| Qualcomm | The question is not crystal clear. The answer should be no, but not sure whether the understanding is aligned.  For known cell, the UE has already measured an SSB before the SCell activation. If the temporary RS is A-TRS, the A-TRS shall be QCLed with the SSB. For this, P-TRS association is not necessary. If the temporary RS is P-TRS, the P-TRS shall be QCLed with the SSB.  For unknown cell, if it is necessary to support temporary RS based SCell activation without using SSB at all, then it is not clear how QCL chain is established. |
| OPPO | No. We suppose the temporary RS is the first signal the UE should deal with (per protocol wise) upon SCell activation. |
| ZTE | No.  Our understanding is that the temporary RS is the first signal upon SCell activation. From this perspective, there is no need to transmit other signals as the QCL source for temporary RS.  Without QCL source for temporary, TRS may need to perform beam sweeping. But this may need to be confirmed with RAN4. |
| CATT | No.  Firstly we would like to further understand the question: the P-TRS is sent during active duration on the to-be-activated cell, or it is required to be sent during the deactivated period? If it is required to be sent during the deactivated period, we share the same understanding with Huawei.  If the intention is to use the P-TRS transmitted during the active period on the known cell, it may be OK. However, considering the P-TRS is unavailable on the unknown cell before it is activated, take SSB as a QCL source is a unified solution for both known cell and unknown cell. |
| Nokia, NSB | In our view, no. |
| vivo | No, otherwise, the activation would likely be further delayed by an additional periodic TRS. The aperiodic TRS can be used as the QCL source during activation, while after the activation, the legacy UE behavior may still be applied. |
| Ericsson | No |
| Futurewei | Not necessary, but can be considered if the QCL requires it. |
| Intel | No. The temporary RS should be the first signal for detection upon SCell activation. |

**Issue-3.2: which source QCL RS can be selected for temporary RS?**

* **Opt 3.2.1:** No need [2][3]
* **Opt 3.2.2:** SSB for at least known SCell [4]

**Question 3.2: which source QCL RS can be selected for temporary RS?**

Companies’ views are very welcome.

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| *Company* | *View* |
| Huawei, HiSilicon | In case of a known SCell, the SSB measured by a UE for measurement report is still detectable according to the definition of known SCell in TS 38.133. Therefore, the SSB can be a QCL source to facilitate temporary RS for AGC and time/frequency synchronization. |
| Qualcomm | Agree with Huawei. |
| OPPO | Opt 3.2.1.  RAN1 decided in previous meeting to use TRS as an expedited RS version to replace the slow SSB. If the SSB prior to SCell deactivation can be the QCL source of TRS, it only means likely the expedited TRS is redundant and therefore not needed. |
| ZTE | Opt 3.2.1.  In the legacy SCell activation procedure, most of latency is caused by SSB receiving and measuring. If SSB is required as the QCL source, then the latency gain may be marginal. |
| CATT | We support Option 3.2.2. Share the same views with Huawei. There has to be a source QCL RS for the temporary RS in order to facilitate the RS reception at UE side. |
| Nokia, NSB | Agree with Huawei |
| vivo | Our understanding is that SSB is **not required** to be the QCL source, but **can be** used by the UE as the QCL source if the SCell is known (i.e., not precluding the UE to use the SSB if possible). The key point is that it should not delay the activation procedure. |
| Ericsson | Last measured SSB as also suggested by other companies |
| Futurewei | SSB of the same cell or another cell, or P/SP TRS of the same cell or another cell may be used as the source. |
| Intel | For known cell, a QCL source of SSB can be determined for the temporary RS. However, as vivo commented, it doesn’t mean UE need to monitor the SSB first then the temporary RS, when UE receives a trigger for fast SCell activation |

**Issue-3.3: for which subsequent RS/channel can temporary RS serve as QCL source?**

* **Opt 3.3.1:** subsequent CSI-RS [2][3][14][16]
* **Opt 3.3.2:** SSB [3]
* **Opt 3.3.3:** initial PDCCH/PDSCH DMRS [16]
* **Opt 3.3.4:** subsequent periodic TRS after SCell activation [4]
* **Opt 3.3.5:** No change to existing QCL framework [15]

**Question 3.3: for which subsequent RS/channel can temporary RS serve as QCL source?**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | Opt.3.3.5 |
| OPPO | Opt 3.3.1, Opt 3.3.2 |
| ZTE | Our understanding is that at least Opt 3.3.1 can be supported. We can FFS other options. |
| CATT | We support option 3.3.5. For option 3.3.1-3.3.4, we are not sure how these options can help to expedite the procedure of SCell activation. |
| Nokia, NSB | Agree with Qualcomm |
| vivo | Opt 3.3.5 is the baseline.  If any optimization is needed, Opt 3.3.4 can be considered. But we are also open to other options (e.g., Opt 3.3.2). |
| Ericsson | If fast activation can be achieved by 3.3.5 then it is good but we are not sure if it is possible. We are OK to discuss this further |
| Futurewei | Opt 3.3.5. |
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#### Issue-4: Timeline for temporary RS and SCell activation

Based on the triggering command, some timelines for temporary RS and SCell activation are proposed. Companies’ views on it are summarized as follows:

* **Opt 4.1**

*“The TRS is triggered r slots after the UE sends HARQ-ACK to the triggering MAC CE, plus 0.5ms MAC-to-PHY processing delay, where r is configured by RRC or indicated by MAC CE.”*[6]

* **Opt 4.2**

*“Offset between Scell activation and temporary RS can be configured by RRC singling and starting point of the offset is the HARQ-ACK feedback slot of triggering command”* [10]

* **Opt 4.3**

*“The actual slot for the triggered TRS can be r slot after the slot the UE sends HARQ-ACK for the PDSCH converting TRS triggering MAC CE, where the r can be configured by RRC, or more flexibly, indicated by the MAC CE.*”[13]

* **Opt 4.4**

*“The timing of A-TRS transmission is defined relative to the PUCCH transmission that carries the HARQ-ACK for triggering command, and the offset value of TRS transmission is indicated in triggering command.”[14]*

**Question 4: which timeline of temporary RS and SCell activation should be supported?**

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Qualcomm | With Alt.2.1.2 for Issue 1, the triggered A-TRS on to-be-activated SCell(s) is used instead of SSB, if the UL DCI triggering the A-TRS is no earlier than slot n + k, where n is the slot where the PDSCH carrying the SCell activation command ends, and k is [k1 + 3ms + 1]. |
| OPPO | The alternatives provided from FL are all related to HARQ-ACK. We think the timeline of TRS transmission should not bind to the HARQ-ACK transmission, where the false detection of HARQ-ACK by gNB could be a trouble-maker. Instead, the timeline of TRS transmission should be associated with HARQ-ACK timing slot (Opt 4.2, but not necessarily the actual HARQ-ACK on PUCCH) or simply the triggering MAC-CE transmission slot. |
| ZTE | It is more appropriate to discuss this issue after RAN1 has decided the triggering command for SCell activation and temporary RS activation. We can postpone the discussion from our perspective. |
| Nokia, NSB | This seems like a premature discussion, would need an agreement on the scheme first before it pays to discuss in detail the timeline setup. |
| vivo | Opt 4.1 or 4.3, assuming that Alt 1.1/1.5/1.6 is agreed. |
| Futurewei | Opt 4.1 or 4.3 |
| CATT | We share the same views with ZTE and Nokia. |
| Intel | Opt 4.3 or 4.4. it gNB doesn’t detect the ACK feedback (UE doesn’t transmit HARQ-ACK or gNB misses the detection), gNB may not transmit the temporary RS. |

#### Issue-5: 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 5.1** The BWP configured by “*firstActiveDownlinkBWP-Id”* [3][4][6][18]
* **Opt 5.2** gNB indicates the BWP along with the indication of triggering the temporary RS [5][11][18]

**Question 5: 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.5.1 |
| OPPO | Opt 5.1 |
| ZTE | Opt 5.2. |
| Nokia, NSB | Opt 5.2, or opt 5.3 (BWP explicitly configured by RRC). |
| vivo | Opt 5.1 |
| Ericsson | Opt. 5.1 |
| Futurewei | The configured BWP can be the default, and the default can be overwritten by the trigger (e.g., a TRS trigger) if the trigger explicitly indicates another BWP. |
| CATT | Although we propose option 5.2 in our contribution as the preference, we don’t have strong view on this issue. We can follow the majority view. |
| Intel | Opt 5.1 |
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### The To-be-activated Scell acquires essential information for activation enhancement from an active cell

#### Issue-6: Tactivation reduction with BS assistance but no temporary RS nor SSB

It is proposed in [4][18] that activation time of the To-be-activated cell can be reduced by acquiring activation information (e.g. synchronization and AGC-related 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 QCL-source cell to assist the activation of the To-be-activated cell, which may speed up the procedure of synchronization and AGC.

**Question 6: Whether it is beneficial for Tactivation reduction that BS assistance information or common property (e.g. frequency/timing synchronization, path loss, coupling loss, RSRP) derived from activated cell?**

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Qualcomm | Not sure what exact solution is considered here. |
| OPPO | In our view, due to RAN4 requirement existing for MRTD (maximum reception timing difference) for NR CA, the co-located activated cell would not know at least the synchronization condition at the UE side even if it knows the condition at gNB Tx side. So the question is not whether it is beneficial, rather, it is about whether it is feasible -- and our understanding is no. |
| ZTE | It is not clear what the BS assistance information refers to in the question here. Suggest to FFS this issue. |
| Nokia, NSB | FFS |
| vivo | Similar to OPPO’s concern. We might consult with RAN4 before making the decision. |
| Futurewei | We think this is beneficial, and the co-located carrier properties are known by the gNB. Here it can be a gNB decision to signal the BS assistance information or not based on the gNB’s implementation. We do not think it is needed to consult RAN4 as RAN4 deals with the minimum requirement. |
| CATT | We share the similar views with Futurewei. We think it is beneficial. |
| Intel | Prefer to discuss the exact solution first |
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## TCSI\_reporting reduction

### Issue-7: Enhancement for CSI reporting

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

* **Opt 7.1** for acquisition of CSI after activation, reuse the existing R15/R16 framework. [2][9]
* **Opt 7.2** short interval P/SP- CSI-RS report [4]

“*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.*”[4]

* **Opt 7.3** remove TCSI\_reporting for the case of FR2 unknown cell[4]

“*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.*”[4]

* **Opt 7.4** Support aperiodic CSI reporting based on PUCCH for the SCell being activated [12]

*“The group-common DCI can include fields at least for bitmap for SCell activation and CSI request. Since group-common DCI does not include any scheduling information for PUSCH, PUCCH-based CSI reporting should be supported. Using a group-common DCI avoid potential errors for HARQ-ACK codebook determination that would occur if the DCI format activating an SCell was missed and the UE was expected to report both A-CSI and HARQ-ACK in a same PUCCH or PUSCH that does not trigger the A-CSI report.”[12]*

**Question 7: which option above of CSI reporting enhancement should be supported?**

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Qualcomm | At least Opt.7.1. FFS any other enhancements. |
| OPPO | At least Opt 7.1. FFS others. |
| ZTE | At least Opt 7.1. FFS others. |
| Nokia, NSB | Opt 7.1. FFS any other enhancements |
| vivo | Opt 7.1. FFS to others. |
| Futurewei | Opt 7.1 |
| CATT | Opt 7.1. FFS to others. |
| Intel | Opt 7.1. FFS to others. |
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## General Issues

* **Question G1:** Whether or not temporary RS should be introduced for unknown cells? [3][16]

Companies’ views are very welcome.

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| --- | --- |
| *Company* | *View* |
| Qualcomm | This may depend on the LS reply from RAN4. |
| OPPO | Yes. The WID does not exclude the unknown cell from efficiency enhancement. |
| ZTE | Yes, but it may be better to confirm this with RAN4. |
| Nokia, NSB | Premature, FFS |
| vivo | It may depend on the reply from RAN4. |
| Futurewei | Yes, pending RAN4 confirmation |
| CATT | Same view with Nokia. It should be discussed after the solution on known SCell is mature. |
| Intel | Wait for RAN4 reply |
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* **Question G2:** Whether or not temporary RS should be introduced for both FR1 and FR2 case?[13]

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Qualcomm | Yes |
| OPPO | Yes. WID explicitly says the efficient activation/deactivation applies to both FRs. |
| ZTE | Yes. We can have an agreements to confirm this. |
| Nokia, NSB | Yes |
| vivo | Yes |
| Futurewei | Yes |
| CATT | Yes |
| Intel | Yes |
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* **Question G3:** 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. [1]

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Qualcomm | FFS |
| OPPO | New RS is probably needed to work either alone or together with A-TRS if repetition is not agreeable to temporary RS, given the current WA on TRS may have issue with RAN4 MRTD requirements. Please see our response in section 3.2.1.1 for Issue-2. |
| ZTE | FFS. |
| Nokia, NSB | FFS |
| vivo | FFS |
| Futurewei | Yes. These RSs are needed for CSI acquisition during the activation. We should allow the joint trigger to trigger them if they are configured by the network. This gives the network more choices. |
| ZTE | FFS. |
| Intel | Yes, assuming CSI report is needed in the SCell activation |
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**Question G4:** Whether or not support additional functionality of temporary RS during SCell activation, e.g. CSI measurement/acquisition, cell search. [2][7][18]

Companies’ views are very welcome.

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| --- | --- |
| *Company* | *View* |
| Qualcomm | FFS |
| OPPO | FFS |
| ZTE | FFS |
| Nokia, NSB | FFS |
| vivo | FFS |
| Futurewei | Yes, as CSI is part of the activation procedure. |
| vivo | FFS |
| Intel | Yes |
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**Question G5:** Whether RAN1 need to clarify whether to support A-TRS for RRC-based SCell activation. [3][15]

Companies’ views are very welcome.

|  |  |
| --- | --- |
| *Company* | *View* |
| Qualcomm | Yes (without optimization). Alt.2.1.2 for Issue 1 enables this. |
| OPPO | Yes. The clarification is needed at least to make RAN2 be aware of. |
| ZTE | Yes. We can first focus on the regular SCell activation procedure. |
| Nokia, NSB | FFS |
| vivo | Yes |
| Futurewei | Yes, a unified design is preferred |
| CATT | FFS |
| Intel | Yes |
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**Question G6:** For cases where Rel15/16 TRS structure is re-used for ‘temporary RS’, whether there is need to define a separate ‘temporary RS’ configuration in addition to already existing TRS configuration. [16]

Companies’ views are very welcome.

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| --- | --- |
| *Company* | *View* |
| Qualcomm | Depends on the RAN4’s feedback. |
| OPPO | Yes if intra-burst repetition of TRS is agreed to be needed, given the existing TRS configuration does not support repetition. |
| ZTE | Maybe it is better to wait for RAN4’s response first. |
| Nokia, NSB | FFS |
| vivo | FFS |
| Futurewei | FFS pending RAN4 input |
| CATT | FFS |
| Intel | FFS pending RAN4 input |
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**Question G7:** whether aperiodic TRS is decoupled with periodic TRS related to the time-domain pattern if aperiodic TRS is served as temporary RS. [2]

Companies’ views are very welcome.

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| --- | --- |
| *Company* | *View* |
| Qualcomm | This is beneficial and should be available. |
| OPPO | A bit confused by the question itself, which seems to ask whether the introduction of temporary RS would change the coupling relationship that is defined in current spec between aperiodic TRS and periodic TRS. In our view, introduction of new temporary RS should NOT change what is already specified; what RAN1 can discuss is the relation between temporary RS and the periodic TRS, which is a brand-new concept in Rel-17. If nothing is agreed or even discussed, there should be no coupling relationship between the two. Anyhow, this does not seem to be an urgent Q&A and the answer depends on whether the temporary RS is specified as a special case of aperiodic TRS or a new RS that just shares something with aperiodic TRS. |
| ZTE | From our perspective, this is beneficial. |
| Nokia, NSB | A-TRS and P-TRS timings should be decoupled. |
| vivo | Depends on the RAN4’s feedback. |
| Futurewei | More clarification is needed |
| CATT | More clarification is needed |
| Intel | More clarification is needed |
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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

1. [R1-2100045](C:\\Users\\wanshic\\OneDrive - Qualcomm\\Documents\\Standards\\3GPP Standards\\Meeting Documents\\TSGR1_104\\Docs\\R1-2100045.zip) Support efficient activation/de-activation mechanism for Scells FUTUREWEI
2. [R1-2100112](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2100112.zip) Discussion on Support Efficient Activation De-activation Mechanism for SCells in NR CA ZTE
3. [R1-2100188](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2100188.zip) Discussion on efficient activation/de-activation for Scell OPPO
4. [R1-2100192](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2100192.zip) Discussion on efficient activation/de-activation mechanism for SCells Huawei, HiSilicon
5. [R1-2100360](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2100360.zip) Discussion on efficient activation and de-activation mechanism for SCell in NR CA CATT
6. [R1-2100475](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2100475.zip) Discussion on efficient activation/de-activation mechanism for Scells vivo
7. [R1-2100679](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2100679.zip) On efficient activation/de-activation for SCells Intel Corporation
8. [R1-2100695](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2100695.zip) Discussion on efficient activation mechanism for SCells NEC
9. [R1-2100721](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2100721.zip) On low latency Scell activation Nokia, Nokia Shanghai Bell
10. [R1-2100795](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2100795.zip) Discussion on efficient activation/de-activation mechanism for SCells in NR CA Spreadtrum Communications
11. [R1-2101067](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2101067.zip) Discussion on efficient activation/de-activation mechanism for SCells CMCC
12. [R1-2101239](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2101239.zip) On efficient activation/de-activation mechanism for Scells Samsung
13. [R1-2101294](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2101294.zip) Fast SCell Activation InterDigital, Inc.
14. [R1-2101364](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2101364.zip) On Efficiency Activation/De-activation for SCells in CA Apple
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16. [R1-2101563](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2101563.zip) Reduced Latency SCell Activation Ericsson
17. [R1-2101566](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2101566.zip) Efficient activation/deactivation of SCell ASUSTeK
18. [R1-2101634](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2101634.zip) Discussion on efficient activation/deactivation mechanism for SCells NTT DOCOMO, INC.

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