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

**E-meeting, April 12 –April 20, 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 April 15.

[104b-e-NR-DSS-02] Email discussion/approval for efficient activation/de-activation mechanism for SCells in NR CA – Frank (Huawei)

* 1st check point: April 15
* 2nd check point: April 20

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:** Number of temporary RS bursts
* **Issue-3:** Time-domain property of TRS
* **Issue-4:** QCL configuration of temporary RS
* **Issue-5:** Associated BWP for temporary RS
* **Issue-6:** Timeline for temporary RS and SCell activation
* **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 or two companies:

* **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. [7][8]
* **Question G2:** Whether or not support additional functionality of temporary RS during SCell activation, e.g. CSI measurement/acquisition, cell search. [7][18]
* **Question G3:** Whether the requirement that a periodic TRS having the same bandwidth and QCL assumptions as the aperiodic TRS has to be configured should be removed at least for an aperiodic TRS being used as a temporary RS for SCell activation. [14]

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 4/14 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: 4/15, and GTW session on 4/14

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

* **Issue-1:** Triggering command for SCell activation/de-activation and temporary RS
* **Issue-2:** Number of temporary RS bursts
* **Issue-3:** Time-domain property of TRS
* **Issue-4:** QCL configuration of temporary RS
* For 2nd check point: 4/20, 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 | Focus on Issue 1, 3, and 4.  The issue 2 (e.g., number of temporary RS bursts and the time gap between the two burst) is now under discussion in RAN4 as indicated in their LS reply. RAN1 should wait for their further inputs. |
| Futurewei | Decide on Issue 1 as the top priority.  Issue 3 can be the 2nd priority.  2 and 4 are more or less the next level of details. |
| Samsung | Fine with the suggestions – Issue 1 can have first priority, Issue 2 can have last priority. |
| OPPO | Ok with FL suggestion. |
| vivo | Ok with FL suggestion. |
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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 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, some options for the trigger of temporary RS and SCell activation were agreed for down-selection. Companies’ views on the three options are summarized as follows, the detailed designs for each option are not listed here.

* Option 1a: MAC CE(s) contained in a single PDSCH to trigger both SCell activation and corresponding temporary RS(s) [1][2][3][4][5][6][8][9][10][12][13][14][19]
* Option 1b: A single DCI to trigger both SCell activation and corresponding temporary RS(s) [3][4][8][11][12][16][17][19]
* 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 [14][18]

Cons and Pros for above options are summarized below.

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|  | Cons | Pros |
| Option 1a | * In case of ACK failure retransmission would be triggered resulting in slightly higher latency. [9] * New MAC CE may be needed. [11] | * Reuse the Rel-15/16 SCell activation MAC-CE, has the least spec impacts. [1][2][3][10] * Largely reusing the existing SCell activation procedure. [5] * Relatively easy to add fields or define new MAC CE as compared to DCI.[9] * No upper bound for number of information bits. [9] * HARQ gain in MAC-CE. [9] * Can be transmitted on any active cell. [9] * Keeping legacy MAC-CE signaling based approach allows for keeping the current functions splitting, minimize the specification impact and standard efforts. [13] |
| Option 1b | * Introduce run-time restriction to CSI report flexibility and the transmission efficiency. [2] * It needs a new association between SCell activation and CSI request field in DCI. [3] * Creates a critical problem of UE incorrectly activating SCell due to DCI false alarm detection. [5][15] * Requires significantly increased physical layer overhead if a new DCI field/format is introduced. [5] * Increased computation complexity for interpreting the DCI information. [9] * Number of information bits are limited by the structure of the DCI format. [9] * UE can monitor maximum (3 scrambled C-RNTI and 1 other) DCI formats over all slots. [9] * The latency reduction of DCI-based approach over MAC-CE based approach is unclear given the fact that HARQ-ACK feedback is commonly required for both. [13] * The reduced latency by the new DCI format may not bring meaningful gain considering the conservative CQI setting at the start of newly activate CC and the ‘slow-start’ characteristic of typical TCP-based applications on the mobile devices. [13] * Support of more than one signaling mechanisms for a single function (i.e., activation/deactivation) unnecessarily complicates gNB schedulers to manage different time gaps for different releases of UEs. [13] * The SCell dormancy operation has been introduced in Rel-16 for activated SCell to handle bursty traffic, balancing between the latency performance and power consumption. Correspondingly, the SCell activation operation is expected to be used only at the starting of bursty traffic session. Hence, the latency reduction by L1 signaling is of less importance. [13] | * Shorten the THARQ. It does not need to decode PDSCH. [3][9] * Little modification of current Rel-15/16 UL DCI format with CSI request field. [11] * No issue from L2 point of view if the DCI is used for SCell Activation and Deactivation. [9] * Use of DCI format 0\_1 or 0\_2 for SCell activation/deactivation is a trivial extension of the Rel-16 functionality for SCell dormancy/non-dormancy with the modification being a change of “dormant/non-dormant BWP” to “deactivated/activated SCell” and therefore practically has no specification impact.[16] |
| Option 2 | * Lead to different arrival order or different timeline requirements between A-TRS triggering and SCell activation command. [2] * A time window should be specified only within which a UE should monitor the DCI trigger of temporary RS. It complicates the gNB scheduling timeline and the UE processing timeline, and increases activation latency.[1] * The non-synchronized (with SCell activation) and non-acknowledged ATRS-triggering DCI would make the gNB-UE handshake protocol in fast SCell activation more complicated. [2] * The existing DCI format only triggers a single TRS burst, specification changes on the DCI format/field are inevitable for triggering two TRS bursts. [5] * Complicates the processing timeline design. [1][5] * Increase of signalling time. [1][11] * How to handle the mis-detection of one of the signalling is also need to be studied. [11] * Results in a larger signaling overhead. [13] * Increases the probability of missing one of the TRS commands or activation command, causing either increased activation latency or overhead of TRS transmission. [13] | * Achieves fast SCell activation by largely reusing the existing signaling and UE procedures. [18] |

In light of the previous agreement for down-selection and the cons-pros summary above, majority of companies still don’t feel that Option 2 has sufficient advantages over its disadvantages that are mainly caused by separate signaling. Two companies believe that Option 2 should be supported before any support of the other two options. Therefore,

**Question 1: Can Option 2 be down-selected out or any response with more elaborated design could compensate any the above cons?**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | No.  We have not reached consensus on cons/pros listed above for the options. It is not appropriate to list them as if they are consensus – they are rather individual companies’ opinions, and the current description is quite subjective. For example, cons of Opt.1a includes “slightly” without explaining how much slight it is compared to other options.  Then we do not think Option 2 has to be down-selected. There is no technical justification.  We do not agree with most of the cons listed above for Opt.2.   * Lead to different arrival order or different timeline requirements between A-TRS triggering and SCell activation command. [2] [QC]: “different timeline” is common for all the options. SCell activation delay is not the same as temporary RS triggering timing. “different arrival order” is not the issue – can be avoided by the gNB scheduler. * A time window should be specified only within which a UE should monitor the DCI trigger of temporary RS. It complicates the gNB scheduling timeline and the UE processing timeline, and increases activation latency.[1] [QC]: UL DCI format having A-CSI request field is monitored on active cells continuously, regardless of whether the SCell is being activated or not. No window is necessary. * The non-synchronized (with SCell activation) and non-acknowledged ATRS-triggering DCI would make the gNB-UE handshake protocol in fast SCell activation more complicated. [2] [QC]: We don’t quite understand the meaning. * The existing DCI format only triggers a single TRS burst, specification changes on the DCI format/field are inevitable for triggering two TRS bursts. [5] [QC]: Option 1a/1b requires more changes on this aspect since the signalling itself is new. * Complicates the processing timeline design. [1][5] [QC]: No new timeline is necessary compared to the legacy procedure. * Increase of signalling time. [1][11] [QC]: The goal is to reduce activation delay compared to legacy SSB-based SCell activation, which is achievable by Opt.2. * How to handle the mis-detection of one of the signalling is also need to be studied. [11] [QC]: In case of miss-detection, the UE uses an SSB for SCell activation. No significant issue is expected. * Results in a larger signaling overhead. [13] [QC]: Not clear whether the signalling overhead is larger. * Increases the probability of missing one of the TRS commands or activation command, causing either increased activation latency or overhead of TRS transmission. [13] [QC]: We do not understand how this observation is made. Option 1a/1b have bigger problem on this aspect. For Option 1a, a UE may fail to decode the MAC-CE for SCell activation command, and then PDSCH re-transmission is necessary, which would cause increased activation latency or overall overhead. For Option 1b, if a HARQ-ACK response to the DCI is not supported, the reliability of the DCI triggering SCell activation will be lower than that for MAC-CE based SCell activation.   We propose to add following con in the cons for option 1a:   * MAC-CE contents cannot be changed when the PDSCH is re-transmitted. If a gNB decides to trigger a temporary RS on a SCell to-be-activated, its timing would be indicated by the MAC-CE. However, if the UE failed to decode the PDSCH carrying the MAC-CE and is re-transmitted, the timing indication contained in the MAC-CE cannot be adjustable. For example, let’s say the MAC-CE triggers temporary RS at the k-th slot after the slot that is 3ms later than the slot where HARQ-ACK for the MAC-CE is transmitted. If the UE failed to decode the PDSCH and gNB re-transmits it, the MAC-CE still triggers temporary RS at the k-th slot after the 3ms + HARQ-ACK response. The value k is not adjustable. From the gNB point of view, adjustability of temporary RS is important, since the scheduler need to take into account data scheduling for many UEs in dynamic manner.   Proponents should clarify how to address the issue. |
| Futurewei | We think the only one that may be down-selected is Option 2, as Options 1a/1b have a lot of support. We are open to suggestions but we do not know if there is any other way out.  To reply Qualcomm’s comment on the con they raised: we do not think the temporary RS timing is absolute; it can be relative to the triggering DCI / HARQ-ACK / etc. that is associated with the successful ACK. |
| Samsung | Support Option 1b. Responses to comments made against option 1b are as follows.  Introduce run-time restriction to CSI report flexibility and the transmission efficiency. [2]  [Samsung]: Not an issue. There is no need for a single 6-bit CSI request field. There is no need for the DCI format to schedule data transmission.  It needs a new association between SCell activation and CSI request field in DCI. [3]  [Samsung]: Yes. That is trivial.  Creates a critical problem of UE incorrectly activating SCell due to DCI false alarm detection. [5][15]  [Samsung]: Same as for dormancy indication (e.g. in case of Type-1 codebook or with DCI 2\_6), or for DCI 2\_0, or for DCI 2\_1, or for DCI 2\_4 – nothing ‘critical’ about it. If data scheduling and HARQ-ACK are needed, that unnecessarily limits how fast an SCell can be activated.  Requires significantly increased physical layer overhead if a new DCI field/format is introduced. [5]  [Samsung]: Not an issue – SCell activation/deactivation is not frequent (and would be much less frequent than DCI-based dormancy indication).  Increased computation complexity for interpreting the DCI information. [9]  [Samsung]: What? :-)  Number of information bits are limited by the structure of the DCI format. [9]  [Samsung]: Not an issue – DCI does not schedule data.  UE can monitor maximum (3 scrambled C-RNTI and 1 other) DCI formats over all slots. [9]  [Samsung]: Yes.  The latency reduction of DCI-based approach over MAC-CE based approach is unclear given the fact that HARQ-ACK feedback is commonly required for both. [13]  [Samsung]: No HARQ-ACK is required (although it may be supported as for dormancy indication).  The reduced latency by the new DCI format may not bring meaningful gain considering the conservative CQI setting at the start of newly activate CC and the ‘slow-start’ characteristic of typical TCP-based applications on the mobile devices. [13]  [Samsung]: That is irrelevant to how fast the activation is; otherwise, no need to specify anything and can keep Rel-16.  Support of more than one signaling mechanisms for a single function (i.e., activation/deactivation) unnecessarily complicates gNB schedulers to manage different time gaps for different releases of UEs. [13]  [Samsung]: No issue, no “gNB scheduler complexity” – common characteristic of all approaches – SCell activation is supposed to be faster for R17 UEs.  The SCell dormancy operation has been introduced in Rel-16 for activated SCell to handle bursty traffic, balancing between the latency performance and power consumption. Correspondingly, the SCell activation operation is expected to be used only at the starting of bursty traffic session. Hence, the latency reduction by L1 signaling is of less importance. [13]  [Samsung]: The whole reason for this WI is to reduce SCell activation latency – if that is not important, no need to agree to anything and can stop this WI. |
| OPPO | To respond QC’s comments.   * Lead to different arrival order or different timeline requirements between A-TRS triggering and SCell activation command. [2] [QC]: “different timeline” is common for all the options. SCell activation delay is not the same as temporary RS triggering timing. “different arrival order” is not the issue – can be avoided by the gNB scheduler.   [OPPO resp.] In our understanding, “different arrival order” comes from the fact that the Option-2 puts SCell activation signaling and A-TRS triggering in separate envelopes, which leaves it possible for the UE to successfully receive one but fail another, and any later retransmission of the failed message would result in “different arrival orders”. gNB scheduler cannot avoid this issue.  “different timeline” comes from the fact that the A-TRS triggering based on DCI does not HARQ ACK. gNB does not know whether the DCI indeed move the UE on the fast track timeline using A-TRS. We admit the HARQ ACK for MAC-CE based activation/triggering can be also miss-detected by gNB, but the possibility/severeness are fundamentally different.   * The non-synchronized (with SCell activation) and non-acknowledged ATRS-triggering DCI would make the gNB-UE handshake protocol in fast SCell activation more complicated. [2] [QC]: We don’t quite understand the meaning.   [OPPO resp.] “non-synchronized” A-TRS triggering refers to different “arrival orders” between A-TRS triggering and SCell activation; non-acknowledged A-TRS triggering refers to no HARQ-ACK for TRS triggering DCI. With such a setup, it is not clear to us whether/when/how to let gNB ensure the UE is on fast track or legacy slow track of SCell activation. It is also unclear to us whether/how the UE should behave at the time when gNB does not know whether the UE is on fast or slow track. We do not think such a protocol is an easy job.   * For QC’s comment on non-adjustability of ATRS triggering parameter in case of HARQ re-transmission of MAC-CE, we agree the non-adjustability but do not think this can be worse than Option 2 in which the A-TRS triggering does not have HARQ re-Tx at all. For Option 1a, gNB can transmit MAC-CE without offering HARQ re-Tx or with maximum one re-Tx provided the interval is large enough between first triggering MAC-CE transmission instance and the moment of A-TRS transmission. This can be gNB scheduler implementation. |
| vivo | Given that the current situation, it seems reasonable to take out option 2.  Regarding Qualcomm’s comments,   * The existing DCI format only triggers a single TRS burst, specification changes on the DCI format/field are inevitable for triggering two TRS bursts. [5] [QC]: Option 1a/1b requires more changes on this aspect since the signalling itself is new.   [vivo]: Firstly, this is not true for option 1a, at least for some alternatives of 1a, e.g., reusing the existing MAC CE. Moreover, the problem is not whether option 1a/1b requires new signaling, the argument is that option 2 is claimed to be supported by reusing the existing Rel-15/16 mechanism, which is actually not the case. Further, modifying a existing interface (DCI field) should also consider backward compatibility, while introduce a new signaling can get rid of it.   * Complicates the processing timeline design. [1][5] [QC]: No new timeline is necessary compared to the legacy procedure.   [vivo]: It is clearly different from the legacy procedure – in R15/16, it is not possible that the TRS is triggered/sent before the SCell is activated, thus there is no timeline issue. However, this restriction would be broken by option 2, that is why timeline issue occurs. |
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## Tactivation reduction

### Temporary-RS based

#### Issue-2: Number of temporary RS bursts

In RAN4 reply LS R1-2104067, there are some conclusions on the temporary RS for SCell activation.

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| **Q1:** to expedite SCell activation, RAN1 is studying whether and under which conditions (e.g. FR1/FR2, known/unknown cell, etc.), how many temporary RS bursts/symbols are required to achieve both UE AGC setting and time/frequency tracking. Does RAN4 have any information to share for these aspects?  [RAN4 Response]: RAN4 had discussed on temporary RS for SCell activation in multiple scenarios (FR1/FR2, known/unknown cell, etc.). So far RAN4 reached the following conclusions:   * SCell to be activated is known and belongs to FR1   + If SCell measurement cycle is equal to or smaller than 160ms     - temporary RS can be used for time/frequency tracking       * 1 burst (2-slot with four CSI-RS resources) is required based on RAN1 working assumptions on temporary RS design provided in the LS R1-2009798.   + If SCell measurement cycle is larger than 160ms     - temporary RS can be used for AGC       * 1 burst (2-slot with four CSI-RS resources) is required     - temporary RS can be used for time/frequency tracking       * 1 separate burst (2-slot with four CSI-RS resources) is required in addition to the one burst required for AGC     - The agreements above apply based on RAN1 working assumptions on temporary RS design provided in the LS R1-2009798.     - FFS: whether minimum gap between the RS symbol(s) for AGC and the RS symbols for time/frequency acquisition is considered to account for UE AGC application time delay       * The minimum gap length is FFS * SCell to be activated belongs to FR2   + If there is at least one active serving cell on that FR2 band and temporary RS for the target SCell is provided, no matter whether the SCell to be activated is known or unknown     - temporary RS can be used for time/ frequency tracking       * The number of temporary RS symbols is under discussion   + If there is no active serving cell on that FR2 band, and the SCell to be activated is known to UE     - temporary RS can be used for fine timing tracking       * The number of temporary RS symbols is under discussion   So far there is no conclusion on whether/how much benefit can be achieved for the temporary RS based SCell activation in other scenarios (e.g. SCell to be activated is unknown and belongs to FR1, SCell to be activated is unknown and belongs to FR2 if there is no active serving cell on that FR2 band). RAN4 will continue the discussion and provide feedback to RAN1 if there is conclusion. |

It can be observed that at least for the case where SCell to be activated is known and belongs to FR1, one a triggered temporary RS for SCell activation may contain one burst of TRS (2-slot with four CSI-RS resources) or two bursts of TRS. RAN1 should take the reply into account, companies’ views are summarized.

* **Opt 2.1:** RRC configures the repetition number for temporary RS [4]
* **Opt 2.2**: The triggering command indicates the repetition number for temporary RS [4]
* **Opt 2.3**: Define a time duration and a periodicity of the duration, the TRS is transmitted during the duration. [4]
* **Opt 2.4** Define a single RS structure with two temporary RS bursts [1][5]
* **Opt 2.5** Redefining the temporary RS burst, e.g. one temporary RS burst contains 4-slot with eight CSI-RS and a minimum gap length is defined (if considered) between the first two slots and the last two slots, one temporary RS burst is triggered regardless of the configuration of SCell measurement cycle. [1]
* **Opt 2.6** The number of temporary RS burst actually triggered is determined according to the configuration of SCell measurement cycle. If SCell measurement cycle is equal to or smaller than 160ms, one temporary RS burst is triggered for time/frequency tracking; If SCell measurement cycle is larger than 160ms, two temporary RS bursts are triggered, one temporary RS burst can be used for AGC, one temporary RS can be used for time/frequency tracking. [1]

**Question 2: Regarding the structure of temporary RS, i.e. how many slots and how many CSI-RS resources, which option above should be selected? Your views on benefit/gain, specification impact, implementation complexity are encouraged.**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | RAN1 should wait for further input from RAN4.  RAN4 is now discussing remaining aspects of the requirements for temporary RS for various SCell activation conditions as indicated in the LS reply. Defining temporary RS structure without further inputs from RAN4 will cause discrepancy between RAN1 and RAN4 and is not preferred. |
| Futurewei | This may be considered as the next level of detailed design. As long as the design meets RAN4 minimum requirements, it can be considered. RAN4 has provided partial answers, e.g., for known cells. We suggest to focus on known cells first, and work on unknown cell after RAN4’s further decision. |
| Samsung | Share the same opinion with Qualcomm. |
| OPPO | The current issue in our view is that the RAN4 feedback is based on known-cell vs. unknown-cell, but the criteria to judge a known or unkown SCell remains partially transparent to gNB. If RAN4 comes up with the same conclusion for both known SCell and unknown SCell, then Opt 2.6 is the best match; otherwise, RAN1 may need more discussion. So in short, RAN1 may want to wait for RAN4 further inputs. |
| vivo | In our view, Opt 2.4 is the most simple approach and does not depend on RAN4 further feedback or known/unknown issue. |
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#### Issue-3: Time-domain property of TRS

In the previous meeting, TRS is selected as the temporary RS. The time-domain property of TRS are analyzed by some companies, including periodic TRS and aperiodic TRS. Companies’ views are summarized as follows:

* **Opt 3.1** Aperiodic TRS [2][3][6][10][14][15]
* **Opt 3.2** Periodic TRS [14]

**Question 3: 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 3.1 and Opt 3.2.  Suppose a UE is configured with periodic TRS on an deactivated SCell. Once the SCell is activated, the UE is able to monitor the periodic TRS. If a periodic TRS occasion is earlier than the SSB occasion, the periodic TRS can be used for SCell activation. There is no reason to exclude use of periodic TRS for SCell activation when it is available. |
| Futurewei | Opt 3.1 has to be supported. Opt 3.2 is also fine but we’d like to clarify that the gNB does not “trigger” P TRS and QCL relation between A-TRS and P-TRS need be defined clearly (see our comments in some later questions on QCL). |
| Samsung | Option 3.1 is enough. No need to complicate overall operation. |
| OPPO | Opt 3.1. |
| vivo | Opt 3.1. |
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#### Issue-4: QCL configuration of temporary RS

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

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

For the working assumption, 4 sub problems should be discussed, and corresponding companies’ views are summarized.

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

* **Opt 4.1.1:** Abandon [2]

“*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 4.1.2:** Confirm [1][6][8]

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

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | Opt 4.1.2. |
| Futurewei | The discussion need jointly consider the following aspect instead of simply confirm/abandon WA:   * For known SCell, SSB/P-TRS are available as QCL source during activation procedure * A-TRS as QCL source for other RS(s) following A-TRS if any during activation procedure * After activation procedure, A-TRS may not be triggered. There will be P-TRS which should be QCL-ed to A-TRS while other signals QCL-ed to P-TRS * In the case of P-TRS transmits early, P-TRS is then QCL source for following transmission.   **Therefore, the associated P/SP TRS and the A-TRS is the QCL source for each other and they serve (jointly) as QCL source for other following transmissions** |
| Samsung | Discuss further. The issue raised in [2] appears to be valid. |
| OPPO | Opt 4.1.1, or discuss further. |
| vivo | The current working assumption is still valid for continuing RAN1 work. We don’t need to rush to confirm it. |
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**Issue-4.2: 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 4.2.1:** 'typeC' with an SS/PBCH block and, when applicable, 'typeD' with the same SS/PBCH block. [1][4][5][6]
* **Opt 4.2.2:** QCL ‘TypeA’ in FR1 and QCL ‘TypeD’ in FR2. [16]

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

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | Opt 4.2.1.  Proponent of Opt 4.2.2 should clarify the intention. |
| Futurewei | The discussion need jointly consider the following aspect instead of simply confirm/abandon WA:   * For known SCell, SSB/P-TRS are available as QCL source during activation procedure * A-TRS as QCL source for other RS(s) following A-TRS if any during activation procedure * After activation procedure, A-TRS may not be triggered. There will be P-TRS which should be QCL-ed to A-TRS while other signals QCL-ed to P-TRS * In the case of P-TRS transmits early, P-TRS is then QCL source for following transmission.   **Therefore, the associated P/SP TRS and the A-TRS is the QCL source for each other and they serve (jointly) as QCL source for other following transmissions** |
| Samsung | OK with option 4.2.1  ‘TypeA’ instead of ‘TypeC’ was a typo. For FR1 vs FR2, RAN4 does not consider QCL-TypeD for FR1. |
| vivo | Opt 4.2.1. |
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**Issue-4.3: 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 4.3.1:** Yes [1][6]
* **Opt 4.3.2:** No

**Question 4.3: For unknown SCell case, whether the SSB/P-TRS of another active cell** **can be indicated as a QCL source for the temporary RS?**

Companies’ views are very welcome.

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| --- | --- |
| *Company* | *View* |
| Qualcomm | FFS  We do not think it is time to discuss the case of unknown cell. There was no working assumption or agreement to support unknown cell. |
| Futurewei | Yes. Cross-carrier QCL is feasible at least for co-located intra-band CA, and is an easy way (arguably the easiest way) to be utilized here to resolve the unknown cell problem. |
| Samsung | FFS. Also relates to Issue 4-1. |
| OPPO | Not sure whether RAN1 can independently make the decision. Inter-cell timing synchronization and inter-cell frequency isolation seem to relate to RAN4 study.  @Qualcomm: according to following RAN1 #102e 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*”,  and the fact that gNB cannot precisely tell known-cell from unknown-cell, in order to offer every known-cell with A-TRS, it is inevitable for gNB to offer A-TRS for more than just known-cell, i.e., to support unknown cell as well (even such support is occasional at current phase). |
| vivo | FFS. According to the LS, RAN4 not yet have the conclusion of the benefit of unknown SCell case. |
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**Issue 4.4 Which RS/channel can be QCLed to temporary RS?**

* **Opt 4.4.1:** subsequent CSI-RS [2] [13]
* **Opt 4.4.2:** SSB [2]
* **Opt 4.4.3:** PDCCH/PDSCH DMRS [18]
* **Opt 4.4.4:** periodic TRS after SCell activation [1]

**Question 4.4:** Which RS/channel can be QCLed to temporary RS?

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | None.  We do not think we need to change any QCL framework. For subsequent CSI-RS, TCI-state is configured per NZP-CSI-RS resource, which can be an SSB or a CSI-RS. For SSB, other RS should not be a QCL source. For PDCCH DMRS, TCI-state can be configured/activated by RRC/MAC-CE. For PDSCH DMRS, TCI-state can be configured/activated/indicated by RRC/MAC-CE/DCI. Periodic TRS after SCell activation has TCI-state configuration, same as for CSI-RS.  As such, the QCL framework is well established. Proponents should explain how/why this should be changed. |
| Futurewei | Opt 4.4.4 should be supported. The A-TRS and P-TRS are essentially the same RS and can corroborate each other whenever needed. See comments to previous related questions.  Opt 4.4.1 and Opt 4.4.3 are already supported, so no further standard impact is necessary.  Opt 4.4.2 is unnecessary and should not be supported. |
| Samsung | Agree with Qualcomm. |
| OPPO | With Opt 4.4.2, additional information is provided to SSB detection, which is certainly beneficial. |
| vivo | Opt 4.4.4 can be considered. |
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#### 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 SCCell 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”* [1][2][5][17]
* **Opt 5.2** gNB indicates the BWP along with the indication of triggering the temporary RS [6][17]

**Question 5: Which option listed above is preferable? Your views on benefit/gain, specification impact, implementation complexity are encouraged.**

Companies’ views are very welcome.

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| --- | --- |
| *Company* | *View* |
| Qualcomm | Opt 5.1 |
| Futurewei | Support at least Opt 5.1 and open to 5.2 depending on the trigger design. |
| Samsung | Opt 5.1 |
| OPPO | Opt 5.1 |
| vivo | Opt 5.1 |
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#### Issue-6: Timeline for temporary RS and SCell activation

Based on the triggering command, some timelines for temporary RS reception and SCell activation are proposed. This issue can be discussed as soon as the issue-1 is completed. Companies’ views on it are summarized as follows:

**For option 1a**

* **Opt 6.1a.1**

*“The offset between the SCell activation triggering and temporary RS can be configured by RRC singling, and starting point of the offset is the HARQ-ACK feedback slot of triggering command.”* [3]

* **Opt 6.1a.2**

*“The TRS triggering offset starts after the end of PUCCH carrying HARQ-ACK for this MAC-CE.”* [4]

* **Opt 6.1a.3**

*“he 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.*” [5]

* **Opt 6.1a.4**

*“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.”* [15]

* **Opt 6.1a.5**

*“The timing of A-TRS transmission is defined relative to the PUCCH transmission that carries the HARQ-ACK for triggering command. The offset value of TRS transmission is indicated in triggering command.”* [13]

**For option 1b**

* **Opt 6.1b.1**

*“The TRS triggering offset starts after the end of PDCCH.”* [4]

* **Opt 6.1b.2**

*“UE sends an ACK after detecting the triggering DCI,The timing between the ACK feedback and the temporary RS is indicated by the triggering DCI.”* [12]

**For option 2**

* **Opt 6.2.1**

*“If the Rel15/16 SCell activation MAC CE is received in slot n, and if the UE receives DCI 0\_1 in a slot later than n+k1+3ms that triggers an A-TRS transmission on the SCell, the UE requirement for maximum allowed SCell activation latency is set by also taking into account the availability of A-TRS transmission on SCell (Specification of this performance requirement is handled by RAN4).”* [18]

* **Opt 6.2.2**

*“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]”* [14]

**Question 6: which timeline of temporary RS should be supported?**

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | Opt 6.2.1 and Opt 6.2.2 should be further considered.  For MAC-CE based indication (Option 1a), the temporary RS has to be later than HARQ-ACK timing + 3ms, same as for other existing MAC-CE based activation procedures. Proponents of lower latency should clarify why it is possible for this particular indication. |
| Futurewei | Open for 6.1a and 6.1b. |
| Samsung | Option 6.1b.1. |
| OPPO | The discussion is highly correlated to triggering signaling being used. It is better to touch this topic after triggering mechanism is decided. |
| vivo | Opt 6.1a.3 |
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### The To-be-activated cell acquires essential information for activation enhancement from active cell

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

It is proposed in [1][8] that activation time of the To-be-activated cell can be reduced by acquiring activation information (e.g. synchronization and AGC-related information, QCL information) from active cell(s) which are co-located with the To-be-activated cell. For example, the BS provides a UE the information of co-located reference active cells or source QCL cell to assist the activation of the To-be-activated cell, no SSB nor temporary RS is needed during the SCell activation procedure which can reduce the activation delay. The co-located SCells can be intra-band cells or adjacent inter-band cells.

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

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | FFS. We need to first establish temporary RS based SCell activation. |
| Futurewei | Yes, it is beneficial at least for co-located intra-band CA. |
| Samsung | FFS. Also relates to previous issues. |
| OPPO | FFS. May also need RAN4 inputs. |
| vivo | FFS. RAN4 may be involved for checking the feasibility and benefit. |
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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** for acquisition of CSI after activation, reuse the existing R15/R16 framework. [9]
* **Opt 8.2** short interval P/SP- CSI-RS report. [1]

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

* **Opt 8.3** remove TCSI\_reporting for the case of FR2 unknown cell. [1]

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

* **Opt 8.4** Support aperiodic CSI-RS transmission during the SCell activation. [13]

*“The A-TRS is served as the QCL source for the subsequent aperiodic CSI-RS triggered by the same activation/deactivation MAC CE command.”*

**Question 8: which option above of CSI reporting enhancement should be supported?**

Companies’ views are very welcome.

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| --- | --- |
| *Company* | *View* |
| Qualcomm | FFS. |
| Futurewei | We proposed an option in our tdoc that A-CSI-RS may be one type of temporary RS, and an A-CSI-RS trigger triggers both the A-CSI-RS and a default A-TRS. we’d like to have this option also considered by companies. |
| Samsung | Opt. 8.1 or Opt. 8.4. |
| OPPO | Opt 8.1. |
| vivo | Opt 8.1. |
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## General Issues

**Question G1:** Whether or not to additionally support AP CSI-RS, P/SP CSI-RS, SRS, and RS based on SSS/PSS as temporary RS, one or more of which may be used during SCell activation depends on network configuration / UE capability. [7][8]

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | The question is unclear to us. |
| Futurewei | At least AP CSI-RS, AP SRS, and AP SSS/PSS should be configurable, optional temporary RS. For example, the AP CSI-RS can be triggered if the gNB needs CSI as soon as it can, the AP SRS can be triggered if the gNB needs DL full MIMO CSI (for TDD) and/or UL full MIMO CSI as soon as it can. |
| Samsung | The proposed schemes may improve throughput immediately after activation but that is short term and unlikely to make a difference on average throughput during the duration an SCell remains active. Can further discuss the associated “complexity vs throughput gain” tradeoff. |
| OPPO | The benefit of introducing these additional supports is unclear in justifying the spec complexity. |
| vivo | The benefits of introducing these RS candidates are not clear. It is also questionable whether the work can be done given the current assigned TUs. |
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**Question G2:** Whether or not support additional functionality of temporary RS during SCell activation, e.g. CSI measurement/acquisition, cell search. [7][18]

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | In general, if a temporary RS is used for AGC and/or time/frequency tracking, it is not able to be used as for CSI measurement. |
| Futurewei | Yes. DL/UL CSI measurement/acquisition, cell search, UL TA, UL PC, etc., should be considered and enhanced if at all possible during SCell activation, so that the SCell can be utilized as soon as possible. |
| Samsung | The temporary RS is limited to a single port and serves AGC and time/frequency tracking purposes, not CSI acquisition. |
| OPPO | Single port A-TRS is not suitable for CSI measurement. For cell search or coarse timing synchronization, maybe RAN1 should wait for RAN4 conclusion on unknown-SCell. |
| vivo | Agree with Qualcomm, Samsung and OPPO – according to the current working assumption, the temporary RS is not suitable for CSI measurement. |
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**Question G3:** Whether the requirement that a periodic TRS having the same bandwidth and QCL assumptions as the aperiodic TRS has to be configured should be removed at least for an aperiodic TRS being used as a temporary RS for SCell activation. [14]

Companies’ views are very welcome.

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| *Company* | *View* |
| Qualcomm | Agree. |
| Futurewei | The requirement should not be removed but amended to cover new cases where the P TRS is sent after the AP TRS. |
| Samsung | Needs to be discussed. |
| vivo | Agree. |
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## Other Issues

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

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| *Company* | *View* |
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# Conclusions

# References

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2. [R1-2102417](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104b\Docs\R1-2102417.zip) Discussion on efficient activation/de-activation for SCell OPPO
3. [R1-2102472](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104b\Docs\R1-2102472.zip) Discussion on efficient activation/de-activation mechanism for SCells in NR CA Spreadtrum Communications
4. [R1-2102504](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104b\Docs\R1-2102504.zip) Discussion on Support Efficient Activation De-activation Mechanism for SCells in NR CA ZTE
5. [R1-2102545](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104b\Docs\R1-2102545.zip) Discussion on efficient activation/de-activation mechanism for Scells vivo
6. [R1-2102612](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104b\Docs\R1-2102612.zip) Discussion on efficient activation and de-activation mechanism for SCell in NR CA CATT
7. [R1-2102685](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104b\Docs\R1-2102685.zip) Discussion on temporary RS MediaTek Inc.
8. [R1-2102768](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104b\Docs\R1-2102768.zip) Support efficient activation/de-activation mechanism for Scells FUTUREWEI
9. [R1-2102804](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104b\Docs\R1-2102804.zip) On low latency Scell activation Nokia, Nokia Shanghai Bell
10. [R1-2102815](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104b\Docs\R1-2102815.zip) Discussion on efficient activation mechanism for SCells NEC
11. [R1-2102903](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104b\Docs\R1-2102903.zip) Discussion on efficient activation/de-activation mechanism for SCells CMCC
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19. [R1-2103675](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104b\Docs\R1-2103675.zip) Efficient activation/deactivation of SCell ASUSTEK COMPUTER (SHANGHAI)

# 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   **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 |