**3GPP TSG-RAN WG2 Meeting #116 electronic R2-21xxxxx**

**Online, Nov. 1st – Nov. 12th, 2021**

**Agenda Item: 8.2.4**

**Source: OPPO**

**Title: [Post115-e][218][R17 DCCA] TRS-based SCell activation (OPPO)**

**Document for: Discussion and decision**

# Introduction

This paper is to trigger the following email discussion TRS based SCell activation after RAN2#115e.

* [Post115-e][218][R17 DCCA] TRS-based SCell activation (OPPO)

 Scope: Discuss RAN2 impacts of TRS-based SCell activation and attempt to draft initial CRs to RRC/MAC to understand the scope.

 Intended outcome: Report + draft CR to MAC/RRC

 Deadline: Long

There are two phases for the email discussion.

* In phase 1: the open issues for TRS based SCell activation will be discussed, including scenarios, RRC configuration, MAC CE design and so on. The deadline of the email discussion phase 1 is: 19th Oct., 2021.
* In phase 2: the RRC CR and MAC CR will discussed. The deadline of the email discussion phase 1 is: 22th Oct, 2021.

**Contact Information**

|  |  |
| --- | --- |
| Company | Email |
| ZTE | liu.jing30@zte.com.cn |
| OPPO | wangshukun@oppo.com |
| Apple | naveen.palle@apple.com |
| Nokia | Jarkko.t.koskela@outlook.com |
| Intel | xun.tang@intel.com |
| Samsung | s\_dg.kim@samsung.com |
| LGE | hassium.kim@lge.com |
| Ericsson | Zhenhua Zou; zhenhua.zou@ericsson.com |
| KDDI | ya-li@kddi.com |
| Futurewei | Jialinzou88@yahoo.com |
| MediaTek | chun-fan.tsai@mediatek.com |
| vivo | yangxiaodong5g@vivo.com |
| CMCC | tangxiaoxuan@chinamobile.com |
| Qualcomm | Punyaslok Purkayastha; punyaslo@qti.qualcomm.com |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

# Discussion

## ***Issue 1: Scenario for TRS based SCell activation***

Upon receiving SCell activation command in slot n, the UE shall be capable to transmit valid CSI report and apply actions related to the activation command for the SCell being activated no later than in slot $n+\frac{T\_{HARQ}+T\_{activation\\_time}+T\_{CSI\\_Reporting}}{NR slot length}$[3].

Tactivation\_time is the main contribution to SCell activation delay and the SSB periodicity will impact the Tactivation\_time a lot. The SSB periodicity can be {ms5, ms10, ms20, ms40, ms80, ms160} and usually 20ms is configured for capacity cell and ms160 is configured for coverage cell. The SSB periodicity increased the SCell activation delay. So RAN1 agree to use TRS to replace the SSB for time-frequency synchronisation for SCell activation [3].

Currently, the SCell can be activated via SCell A/D MAC CE or RRC signaling directly while SCell addition. However, RAN1 only consider MAC CE based Scell activation for fast SCell activation [3].

**Q1: Do companies agree that only MAC CE triggered SCell activation will apply TRS based SCell activation, i.e. RRC triggered SCell activation will be excluded in R17?**

|  |  |  |
| --- | --- | --- |
| Company | Agree?(Yes or No) | Comments |
| ZTE | No | We understand the discussion in RAN1 mainly focus on MAC CE triggered SCell activation, but for RRC triggered SCell activation, we prefer not to exclude it and we think there is no much effort to support it. In R16, RAN2 discussed “TCI state indication at direct SCell activation”, and agreed that direct SCell activation works if only one TCI state is configured in RRC message. The similar mechanism can be applied to TRS based SCell activation. For example, in the RRC message used to trigger direct SCell activation, if only one set of temporary RS configuration is configured for the SCell, this TRS will be activated directly.On the other hand, in R16, RAN2 decided not to enhance RRC message to explicitly indicate the TCI state used at SCell activation, because the issue was raised too late. In R17, if companies agree, it is possible to consider this enhancement, and apply it to both TCI state and TRS indication, in order to make “RRC-based SCell activation” more useful.  |
| OPPO | Yes  | First, we have no strong opinion to support RRC triggered SCell activation based on TRS.If RAN2 agree to support it, one LS to RAN1 is necessary to check how to define “triggeroffet” and corresponding time line. Because RAN1 only define the trigger offset based on the MAC CE reception, not RRC. |
| Apple | No strong view | We will first atlesat do MAC CE based and can discuss about RRC based. |
| Nokia | Yes | If RRC case requires lengthy discussion we prefer to keep it out for now especially as RRC based activation is slower than MAC – so gains from this is not that obvious anyway due to longer RRC processing delay..  |
| Intel | Yes | Ok to exclude RRC triggered SCell activation, as MAC CE can work well and RAN1 is already working on it. |
| Samsung | No | There seems no reason to exclude RRC based one given that SCell activation can be indicated by MAC CE or RRC in legacy. In Rel-15 LTE, short CSI reporting was introduced with similar motivation and can be triggered by MAC CE and RRC. |
| LGE | - | We have no strong view on RRC triggered SCell activation based on TRS and prefer to focus MAC CE based activation first. |
| Ericsson | Yes | We prefer focusing on the MAC CE approach first and excluding the RRC approach from Rel-17, since the latter needs to involve RAN1 as OPPO indicates.One minor wording comment: the first part of the question hints that DCI approach is ruled out too, which should be up-to RAN1. We are fine with the second part, i.e., to exclude the RRC. |
| KDDI | No strong view | RRC based can be discussed if time is allowed. |
| Futurewei | Yes | First, we support RAN1 agreement that MAC CE triggered SCell activation can apply TRS. We consider it is the baseline in R17.RRC messages could also be used to activate SCell. But RRC message is slower. This feature should be driven by RAN`1. RAN2 should get input from RAN1 whether it is beneficial and worth the effort to support TRS when SCells are activated by RRC messages.  |
| MediaTek | No strong view | We think that RRC-based solution should as be supported. However, we also agree to finialize the MAC CE solution first. |
| vivo | Yes | In R17, MAC CE based solution has been discussed sufficiently. We are not sure whether RRC based solution works fine for this scenario yet.But we are OK with not excluding RRC triggered SCell activation. |
| CMCC | No strong view | We agree that we firstly focus on MAC CE approach but we are open to RRC triggered SCell activation. |
| Huawei, HiSilicon | Yes | We understand RAN1 only discussed MAC CE based activation, so we prefer to complete the corresponding RAN2 work first. We can come back on RRC case if time allows. |
| Qualcomm |  Please see comments | It is not quite clear. There are RAN1 (and possibly RAN4) impacts, so this question needs to be addressed in RAN1 first. It seems to us that RAN2 cannot decide on this alone.  |
|  |  |  |
|  |  |  |

In R16 DCCA enhancement, the activated SCell state can be in dormancy beaviour or non-dormancy behavior, i.e. the DL active BWP is a dormant BWP or not. For MAC CE based SCell activation, when the SCell is activated from deactivated state, the BWP indicated by *firstActiveDownlinkBWP-Id* will be active BWP. However, if *firstActiveDownlinkBWP-Id* is dormant BWP, it is not clear whether the TRS can be activated or not in this case.

|  |
| --- |
| **Copy from TS 38.321 g50**1> if an SCell is configured with *sCellState* set to *activated* upon SCell configuration, or an SCell Activation/Deactivation MAC CE is received activating the SCell:2> if the SCell was deactivated prior to receiving this SCell Activation/Deactivation MAC CE; or2> if the SCell is configured with *sCellState* set to *activated* upon SCell configuration:3> if *firstActiveDownlinkBWP-Id* is not set to dormant BWP:===omit some text===3> else (i.e. *firstActiveDownlinkBWP-Id* is set to dormant BWP):4> stop the *bwp-InactivityTimer* of this Serving Cell, if running.3> activate the DL BWP and UL BWP indicated by *firstActiveDownlinkBWP-Id* and *firstActiveUplinkBWP-Id* respectively.===omit some text===== |

**Q2: Do companies agree that only when the following conditons are met, the TRS can be activated for fast SCell activation?**

**(a) The TRS for SCell activation is configured for this SCell;**

**(b) The SCell is activated from deactivated by SCell A/D MAC CE;**

**(c) The BWP indicated by *firstActiveDownlinkBWP-Id* is not dormant BWP;**

|  |  |  |
| --- | --- | --- |
| Company | Agree?(Yes or No) | Comments |
| ZTE | No for (b) | 1. seems obvious;
2. See our response to Q1, we prefer to also consider RRC based SCell activation, not to limit it to MAC CE based approach;
3. We are fine to not consider dormant BWP, in our view, network may wants to speed up SCell activation procedure because of the increased data volume. It is less likely to change it into dormant state in this case.
 |
| OPPO | Yes  | 1. It is obvious.
2. It highlights the SCell is activated from deactivated state.
3. If the fist active DL BWP is dormant, there will be no data reception and transmission immediately, so there is no necessary to use TRS, SSB is enough.
 |
| Apple | Yes, but for (b) we can discuss later. |  |
| Nokia | Yes  |  |
| Intel | Yes | As TRS is for fast activation, dormancy is not likely to be the target use case. |
| Samsung | Yes only for (a) and (c) | Regarding (b), we prefer to cover RRC based triggering as well. |
| LGE | Yes | Regarding (c), network should guarantee that firstActiveDownlinkBWP-Id is not dormant BWP.  |
| Ericsson | - | I understand the question as “all of the following conditions” not “any of the following conditions”. But they all seem obvious and not sure the need to discuss(?)1. Straightforward
2. can be rephrased to TRS is activated
3. This is up-to the network implementation and the UE just needs to follow the previous two conditions.
 |
| KDDI | Yes | 1. Seems obvious
2. Seems fine, RRC based activation can also be an option
3. Dormant BWP is not needed as the target is to fast active Scell
 |
| Futurewei | Yes | We support b) as the baseline.  |
| MediaTek | Yes for a) and c) | b) could be further discussed.For c), we see no reason to use TRS-based activation if the target state is dormant.  |
| vivo | Yes | (a) Obvious;(b) If we tend to only support MAC CE based solution, then the description in (b) is enough;(c) We think TRS-based SCell activation has limited optimization when The BWP indicated by firstActiveDownlinkBWP-Id is dormant BWP |
| CMCC | Yes |  |
| Huawei, HiSilicon | Yes | For (c), in R16, the UE will not report the aperiodic CSI for the dormant BWP as specified in MAC as below. If dormant BWP can be active BWP during SCell activation, to allow TRS RAN2 need to modify the behaivors of UE in the dormant BWP. 1> if a BWP is activated and the active DL BWP for the Serving Cell is dormant BWP:2> stop the *bwp-InactivityTimer* of this Serving Cell, if running.2> not monitor the PDCCH on the BWP;2> not monitor the PDCCH for the BWP;2> not receive DL-SCH on the BWP;2> not report CSI on the BWP, report CSI except aperiodic CSI for the BWP; |
| Qualcomm | Yes | Since there is no data transmission over the SCell when SCell is dormant, there does not seem much benefit in lowering the SCell activation delay by using TRS based activation.  |
|  |  |  |
|  |  |  |

## ***Issue 2: MAC CE design for TRS based SCell activation***

In RAN1#105e, RAN1 reached the following down-selection, i.e. option 1.1 and option 1.2, for MAC CE design. In last RAN2 meeting, three companies [1][2][3] provide following reasons to prefer option 1.1.

* Usually it is an implementation issue to transmit two MAC CEs either jointly in one PDSCH or separately in two PDSCHs. The gNB makes the decision depending on available resources and system efficiency. For Opt 1.2, RAN2 would need to add the restriction that two MAC CEs for triggering the RS need be in one PDSCH.
* the UE which receives the legacy MAC CE needs to check whether the new MAC CE for temporary RS is included or not in the same PDSCH, and then the UE follows the Rel-17 UE behaviour or the legacy UE behaviour accordingly.
* Opt 1.2 still needs to define a new MAC CE.

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

**Q3: Do companies agree that a new MAC CE is defined to trigger both SCell activation and corresponding temporary RS, i.e. the new MAC CE includes SCell A/D part and TRS activation part?**

|  |  |  |
| --- | --- | --- |
| Company | Agree?(Yes or No) | Comments |
| ZTE | Yes | We support Option 1.1. For Option 1.2, a new MAC CE still needs to be defined, so the standard work is same as Option 1.1. In addition, so far, we haven’t specified any case that two MAC CEs must be sent in one PDSCH, and there is no motivation because there is no different from sending a combined MAC CE (Option 1.1).  |
| OPPO | Yes  | One MAC for both SCell activation and TRS activation is better. It is weird to force two MAC CE in one PDSCH. |
| Apple | Yes for Op 1.1 | Cleaner with one MAC CE using op1.1 |
| Nokia | Yes | We think it is cleaner and simpler if we have one MAC CE doing both activation and TRS activation. |
| Intel | Yes | It’s more convenient for UE to rely on one MAC CE for SCell activation. |
| Samsung | Yes | However, we need to note that a new MAC CE can indicate whether to activate TRS or not when SCell is activated, i.e. it should cover the functionality of Rel-15 SCell activation/deactivation MAC CE.  |
| LGE | Yes | One MAC CE operation is simpler than separate MAC CE operation. |
| Ericsson | Yes | It seems that the TRS triggering is always tied with the SCell activation, and so no clear use case for option 1.2. |
| KDDI | Yes | one new MAC CE seems cleaner and simpler. |
| Futurewei | Yes with comments | We support a new MAC CE which includes both SCell A/D part and TRS activation part. TRS activation part could be used to indicate the TRS associated with a specific cell to be activated.We also support pre-configuration of default TRSs and using the existing SCell activation MAC CE format to also activate the default TRSs if they are configured.  |
| MediaTek | Yes | One new MAC CE is more starigforwad. |
| vivo | Yes | If the MAC CEs for both triggers are defined seperately, an R17 UE still needs to check whether TRS trigger MAC CE exists when it receives the SCell activation trigger MAC CE. |
| CMCC | Yes | Separate MAC CEs for SCell activation and TRS are less efficient. |
| Huawei, HiSilicon | Yes  | We also prefer option 1.1 |
| Qualcomm | Yes |  |
|  |  |  |
|  |  |  |

In legacy R15/16 SCell A/D MAC CE, each SCell will map to one bit in MAC CE, the corresponding bit is setting to 1 means to activate the SCell, otherwise, it means deactivated the SCell. In the new MAC CE for both SCell activation/deactivation and TRS activation, it is reasonable to includes all SCell’s corresponding bit for SCell activation as legacy R15/16 SCell A/D MAC CE.

|  |
| --- |
| Figure 6.1.3.10-1/2: SCell Activation/Deactivation MAC CE of one octet/four octets |

|  |  |
| --- | --- |
| 57 | SCell Activation/Deactivation (four octets) |
| 58 | SCell Activation/Deactivation (one octet) |

Two LCIDs are defined for SCell A/D MAC CE for “one octet” and “four octet” respectively. However, it is not clear how to set LCID for new MAC CE for both SCell activation and corresponding TRS activation.

**Option 1:** Define two new LCID for the new MAC CE for “one octet” SCell activation indication and “four octet” SCell activation indication respectively.

**Option 2**: (Implicit) Resue the LCID of SCell A/D MAC CE for new MAC CE, and the UE will decide the MAC CE is leagacy SCell A/D MAC CE or new MAC CE according to whether there is at least one SCell configdured with TRS for SCell activation.

**Option 3**: (Explicit) Resue the LCID of SCell A/D MAC CE for new MAC CE, and network will indicated UE that it is leagacy SCell A/D MAC CE or new MAC CE via RRC signalling.

**Q4: Which option do companies prefer to define LCID to address new MAC CE if yes to Q3?**

|  |  |  |
| --- | --- | --- |
| Company | option?(1/2/3) | Comments |
| ZTE | Option 1 | Option 1 is clearer and cleaner.Option 2 and 3 are complex without clear benefit.  |
| OPPO | Option 3 is better,Option 1/2 are acceptable | Option 1 will waste two LCID and the reserved LCIDs are few and only 35-46.Option 2 and 3 will reuse LCIDs for SCell A/D MAC CE. It is obvious that if new MAC CE is used and legacy SCell A/D MAC Ce will not used anymore for this UE. |
| Apple | Op1  | It’s simpler and cleaner. |
| Nokia | Option 1 | simhpler, cleaner and simply easier to specify. We do not see any benefit going for option 2 or 3 |
| Intel | Option 1 | We prefer new LCID which doesn’t impact the usage of legacy MAC CE.  |
| Samsung | Option 1 | Other options make UE implementation complicated. |
| LGE | Option 1 | We don’t see a large benfit on Option 2 and 3 while Option 1 is simpler and cleaner. |
| Ericsson | Option 1 with eLCID | There are sufficient spaces in eLCID. The codepoint for eLCID is large, see belowTable 6.2.1-1b Values of one-octet eLCID for DL-SCH

|  |  |  |
| --- | --- | --- |
| Codepoint | Index | LCID values |
| 0 to 244 | 64 to 308 | Reserved |

RAN1 is still discussing what/how to indicate in the MAC CE. The new MAC CE would most likely have a different content from the legacy MAC CE, and thus option 2/option 3 of the same LCID means a fundamental change in the MAC CE design which is not preferred. |
| KDDI | Op1 | Op1 is simpler and cleaner. |
| Futurewei | Option 2 and/or option 1+ | Option 2 is sufficient if the default TRS configured by RRC is applied at the activation. The presence of TRS configuration in RRC would serve the purpose of the option 3. If RAN2 would support the RAN1 alternative of allowing the flexibility of that MAC CE could be used to select the alternative TRSs, the option 1 would be used to carry the SCell activation bit map plus the TRS index associated with each activated SCell. |
| MediaTek | Option 1 | Simple and cleaner as also commented by other companies |
| vivo | Option 1 | For Opt2, it requires more UE implementation work without explicit benifit.For Opt3, it does not provide any further benefit except from reusing LCID while introducing further works for RRC signalling. |
| CMCC | Option 1 | We prefer Option 1. |
| Huawei, HiSilicon | Option 1  | We think option 1 is simpler. |
| Qualcomm  | Option 1 | Option 1 and Option 2 both work. Option 1 is simpler.  |
|  |  |  |
|  |  |  |
|  |  |  |

In RAN1#106e, RAN1 agreed that

|  |
| --- |
| **Agreement** (containing the common part of Alt1 and Alt2 in the next agreement)*To trigger temporary RS,* * *MAC-CE at least provides the following information:*
* *temporary RSs are to be triggered on X out of Y (Y≥X) to-be-activated SCells, respectively, while no temporary RS is to be triggered on the other to-be-activated SCells.*
* *The following information can be provided by RRC for temporary RS for each SCell*
* *The number of RS bursts and the gap length between the RS bursts (Opt 2.3.3)*
* *Triggering offset of temporary RS (Opt 2.3.4)*
* *QCL information (Opt 2.3.5)*

*FFS: the maximum number of temporary RS per cell/per UE**Note: Reusing A-TRS triggering framework is not precluded.** *Information for 0, 1, or more temporary RS can be provided for each configured SCell*

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

Based on RAN1 agreements in RAN1#106e, there are two alternatives to define the MAC CE for TRS activation part.

|  |  |  |
| --- | --- | --- |
| **Alternatives**  | **Comments**  | **Pros./Cons.** |
| Alt 1: Bitmap approach in MAC-CE | The MAC CE will include temporary RS index for each SCell, i.e. Z bit block. | Pros: No need of pre-confguartion in RRC signaling.Cons: .* The signalling overhead of MAC CE is high.
 |
| Alt 2: Reuse A-TRS triggering framework | The MAC CE will include temporary RS trigger state index for UE, and the temporary RS trigger state index refers to the entry number in list of TRS trigger state configuration. Each state will contains each SCell’s TRS trigger state and which TRS is triggered. | Pros: Reuse A-TRS triggering framework. And the signalling overhead of MAC CE is low.Cons: * the temporary RS trigger state index will be huge.
* The new MAC CE is needed.
* The RRC needs to configure the list of temporary RS trigger state. The network should ensure to configure all possible case of TRS trigger of each SCell and each TRS in one SCell.
 |

**Q5: Which Alternative do companies prefer for TRS activation part in the new MAC CE?**

|  |  |  |
| --- | --- | --- |
| Company | Alt 1/2? | Comments |
| ZTE | Alt 2 | We have provided some comments to the Pros/Cons part. In general, we support Alt 2 because:1. Alt 2 needs less specification effort, because it reuses the existing A-TRS trigger state mechanism, so the defined parameters can be reused mostly (e.g. CSI-AperiodicTriggerStateList).
2. Alt 1 causes more signalling overhead in MAC CE, because each SCell will be mapped to Z-bits. But Alt 2 only requires few bits in MAC CE (e.g. 7 bits can represent 128 trigger states)
 |
| OPPO | Alt 1 | Alt 1 is clear and easy to understand. The format of MAC CE is also alighn with SCell A/D MAC CE design.Alt 2 is complex for both network and UE. |
| Apple | Alt2 | This has been the case for other PHY configs using MAC CE. |
| Nokia | Alt 2 type of approach | We assume one needs to only configure at most couple trigger states per cell. So the overhead is not a issue in our view. Alt-2 is good starting point for CR development |
| Intel  | Alt2 | We are also concerned abou the final MAC CE size, and prefer Alt2 with low signalling overhead.  |
| Samsung | Alt 2 |  |
| LGE | Alt1 | Considering TRS configuration with multiple SCell, Alt2 lead to RRC signalling overhead becuase Alt2 has to consider all combination of SCells. We think Alt1 is simpler and clearer since it is aligned to legacy SCell A/D MAC CE. |
| Ericsson | Alt2 | Alt2 is the legacy A-TRS triggering mechanism. We don’t see any issues with this (e.g., complain of RRC signalling overhead in other WIs) and prefer not introducing another mechanism.  |
| Futurewei | Alt 1 | We prefer Alt1, see explanation in Q4.We would support Alt 2 only if CSI reporting is also triggered using MAC CE for SCell activation. |
| MediaTek | No strong view | It is our understanding that both alternative work ? Should we also wait RAN1’s further conclusion on this?  |
| vivo | Alt 1 | Although Alt 1 needs more bits for MAC CE, since TRS-based SCell activation is for SCell activated from deactivation which is not a relatively frequent situation, the cost in MAC CE is acceptable.For Alt 2, it require fewer bits in MAC CE, but it may need much more RRC (pre)configuration which can be quite complex and not friendly for network. |
| CMCC | Alt 2 | Alt 2 can reuse the legacy procedure of A-TRS triggering mechanism and has lower signalling overhead of MAC CE. |
| Huawei, HiSilicon | Alt 1 | If the SCell is deactivated for a while, there is a need for more flexibility in the choice of TRS, so it won't be sufficient to have a few trigger states. Therefore, we suggest Alt 1.However, we can also wait for RAN1 to decide. |
| Qualcomm | Alt 2 | The existing A-TRS framework includes the range of values of TRS bursts, offsets, and resource configurations in RRC configuration signaling that is required for the feature. We don’t see a need for introducing additional signaling. |
|  |  |  |
|  |  |  |
|  |  |  |

If Alt1 is chosen, please see the below text for Q6a.

In RAN1#105e, RAN1 agreed that the number of temporary RS bursts and TRS triggering offset are indicated in MAC CE and FFS to which field in MAC CE is used.

In RAN1#106e, RAN1 agreed that Z-bit block in the bitmap corresponds to a SCell indicate temporary configuration index will be indicated in MAC CE.

So how to indicate these information in MAC CE is not clear.

|  |
| --- |
| **Agreement**For efficient activation of a Scell (in known Scell case), at least the number of temporary RS bursts is indicated by a field in new MAC-CE* The number of temporary RS bursts is RRC configurable.
* FFS: which field in MAC-CE is used and how this field is associated with the number of bursts
* For the purpose of designing temporary RS Scell activation, there is no RAN1 specification impact for the case where the number of indicated temporary RS bursts is smaller than what is expected by the UE

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

**Option 1**: The number of temporary RS bursts and TRS triggering offset are configured per temporary RS in RRC signaling and only temporary configuration index is included in MAC CE for TRS activation part. The number of temporary RS bursts and TRS triggering offset are indicated in MAC CE implicitly via temporary configuration index.

**Option 2**: The number of temporary RS bursts and TRS triggering offset are configured per UE in RRC signaling. The number of temporary RS bursts and TRS triggering offset are indicated explicitly alone with temporary configuration index in MAC CE for TRS activation part.

**Q6a: Which option do companies prefer for information included in MAC CE, if Alt1 is chosen?**

|  |  |  |
| --- | --- | --- |
| Company | option?(1/2/3) | Comments |
| OPPO | Option 1 | We prefer that the number of temporary RS bursts and TRS triggering offset are configured per temporary RS.The new MAC CE will include SCell A.D part and a list of TRS index corresponding to the SCell index from low to high who is configured with TRS and is activated from deactivated state. |
| LGE | Option 1 | We think Option 1 simplifies MAC CE design and only Ci field and temporary configuration index is included.The Ci field in the new MAC CE is interpreated as legacy and the temporary configuration index for SCell configured with TRS is always included in MAC CE when the SCell is activated. |
| Futurewei | Option 1 with comments | The option 1 would have less signaling overhead at the MAC. The offset and the gap may need to be a bit more dynamically supported. Further study is deserved. |
| vivo | Option 1 | We do not see the need to dedicatedly configure the number of temporary RS bursts and TRS triggering offset per UE although it is a bit more flexible for network. |
| Huawei, HiSilicon | Option 1 | Option 1 can reduce the size of MAC CE |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

If Alt2 is chosen, only temporary RS trigger state index is included in MAC CE for TRS activation part for all SCells.

**Q6b: Do companies agree only temporary RS trigger state index is included in MAC CE for TRS activation part for all SCells configured with TRS, if Alt2 is chosen?**

|  |  |  |
| --- | --- | --- |
| Company | Agree?(Yes/No) | Comments |
| ZTE | Yes | So far, we haven’t idenfied other informations that are needed.  |
| Apple | Yes |  |
| Nokia | Yes |  |
| Intel | Yes |  |
| Samsung | Yes |  |
| Ericsson | Yes | The word “only” needs to be removed, otherwise it sounds like the SCell index is not needed either.  |
| Futurewei |  | Suggest to further study. |
| CMCC | Yes |  |
| Qualcomm | Yes |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

## ***Issue 3: RRC configurations for TRS based SCell activation***

|  |
| --- |
| **Agreement** (containing the common part of Alt1 and Alt2 in the next agreement)*To trigger temporary RS,* * *MAC-CE at least provides the following information:*
* *temporary RSs are to be triggered on X out of Y (Y≥X) to-be-activated SCells, respectively, while no temporary RS is to be triggered on the other to-be-activated SCells.*
* *The following information can be provided by RRC for temporary RS for each SCell*
* *The number of RS bursts and the gap length between the RS bursts (Opt 2.3.3)*
* *Triggering offset of temporary RS (Opt 2.3.4)*
* *QCL information (Opt 2.3.5)*

*FFS: the maximum number of temporary RS per cell/per UE**Note: Reusing A-TRS triggering framework is not precluded.** *Information for 0, 1, or more temporary RS can be provided for each configured SCell*
 |

Based on RAN1#106e agreements, RAN1 agreed that following parameters are configured for temporary RS in RRC signanling.

* The number of temporary RS bursts;
* gap length between the RS bursts;
* The candidate value(s) of triggering offset(s);
* A list of temporary RS;

Based on Q6a, it is not clear the number of temporary RS bursts and triggering offset are configured per TRS or per SCell.

**Q7: Companies are invited to provided their opinion on whether the following parameters are configured per SCell or Per TRS configuration?**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Company | Number of burst(per SCell/per TRS) | gap length (per SCell/per TRS) | triggering offset(per SCell/per TRS) | QCL info(per SCell/per TRS) |
| ZTE | We think it is premature to discuss this. In our understanding, it is up to RAN1 to decide which granularity should be applied.  |
| OPPO | per TRS | per TRS | per TRS | per TRS |
| Apple | Let RAN1 decide. |
| Nokia | UP TO RAN1 and not relevant to RAN2 apart from ASn.1 so no need to care so much in RAN2 | UP TO RAN1 | UP TO RAN1 | UP TO RAN1 |
| Intel | Ok to wait until a decision on down-selection between Alt 1 and Alt 2 is made. |
| Samsung | Wait for RAN1 | Wait for RAN1 | Wait for RAN1 | Wait for RAN1 |
| Ericsson | Up to RAN1 | Up to RAN1 | Up to RAN1 | Up to RAN1 |
| Futurewei | per TRS sounds reasonable, should be confirmed by RAN1 | per TRS sounds reasonable, should be confirmed by RAN1 | per TRS sounds reasonable, should be confirmed by RAN1 | per TRS sounds reasonable, should be confirmed by RAN1 |
| MediaTek | Prefer RAN1 to make the design |
| vivo | per TRS | per TRS | per TRS | per TRS |
| CMCC | Up to RAN1 | Up to RAN1 | Up to RAN1 | Up to RAN1 |
| Huawei, HiSilicon | per TRS | per TRS | per TRS | per TRS |
| Qualcomm | Per SCell. Based on the existing RRC configuration, UE can identify all these parameters (number of bursts, gap length, triggering offset, QCL info) that are defined per SCell. | Per SCell | Per SCell | Per SCell |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Currently, trs-Info in NZP-CSI-RS-ResourceSet is configured to indicate TRS configuration in R15. It is not clear how to configure temporary RS for SCell activation.

NZP-CSI-RS-ResourceSet ::= SEQUENCE {

 nzp-CSI-ResourceSetId NZP-CSI-RS-ResourceSetId,

 nzp-CSI-RS-Resources SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourcesPerSet)) OF NZP-CSI-RS-ResourceId,

 repetition ENUMERATED { on, off } OPTIONAL, -- Need S

 aperiodicTriggeringOffset INTEGER(0..6) OPTIONAL, -- Need S

 trs-Info ENUMERATED {true} OPTIONAL, -- Need R

 ...,

 [[

 aperiodicTriggeringOffset-r16 INTEGER(0..31) OPTIONAL -- Need S

 ]]

}

**Option 1**: Based on extension of NZP-CSI-RS-ResourceSet to configure temporary RS for SCell activiaton, i.e. including the temporary RS related new parameters in NZP-CSI-RS-ResourceSet.

**Option 2**: Define a new IE, .e.g temporaryRS-Config, to configure temporary RS for SCell activiaton.

**Q8: Do companies agree to introduce a new IE, e.g. temporaryRS-Config, to configure tempory RS for SCell activation? And one list of temporaryRS-Config is configed in CSI-MeasConfig IE for one SCell.**

**The temporaryRS-Config IE includes:**

* The number of temporary RS bursts, gap length between the RS bursts, the candidate value(s) of triggering offset(s); QCL information if agree per TRS configuration;
* Temporary RS configuration; FFS based on NZP-CSI-RS-Resource or NZP-CSI-RS-ResourceSet (This FFS is up to RAN1).

|  |  |  |
| --- | --- | --- |
| Company | Agree?(Yes/No) | Comments |
| ZTE | Postpone | We prefer to postpone this discussion until RAN1 concludes more details on the RS bursts, and we understand we can start our RRC work until receives the RRC parameter list from RAN1.  |
| OPPO | Yes  | New IE for temporary RS is defined. It is clear and reduce the impact to leacy NZP-CSI-RS configuration. |
| Apple | Prefer ZTEs views |  |
| Nokia | Wait RAN1 | RAN1 needs to provide parameters needed before we can discuss this level of detail |
| Intel | Postpone | Ok to wait until a decision on down-selection between Alt 1 and Alt 2 is made. |
| Samsung | Postpone | It would be better to wait for RAN1. |
| LGE | Wait RAN1 | Agree with views to discuss later after RAN1 conclusion |
| Ericsson | Postpone | Agree with ZTE |
| Futurewei | Yes in principle | The stage 3 details can be specified after we get the detailed L1 parameters confirmed by RAN1. |
| MediaTek | Wait RAN1 |  |
| vivo | Yes | There is new information to be configured for TRS-based SCell activation. New IE is needed. |
| CMCC | Postpone |  |
| Huawei, HiSilicon | Yes | New IE is clearer, but also fine to wait and see RAN1’s input on RRC parameter. |
| Qualcomm | No | If Alt 2 is chosen in Q5, there is no need to introduce a new IE. |
|  |  |  |
|  |  |  |
|  |  |  |

In [2], RAN4 LS indicates 2 RS burst are required for AGC and time/frequency tracking respectively. It is not clear how to configure the 2 TRS burst in RRC signalling.

|  |
| --- |
| * SCell to be activated is known and belongs to FR1 and if SCell measurement cycle is larger than 160ms,

It is confirmed in [R4-2104067] [R4-2105799] that * + 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
 |

**Option 1**: One burst for TRS configuration is configured and one indication is configured to indicate whether there is another burst repetition.

**Option 2**: Two separate burst for TRS configuration are configured to indicate two TRS bursts.

**Q9: Which option do companies prefer to configure 2 burst TRS configuration?**

|  |  |  |
| --- | --- | --- |
| Company | Agree?(option 1/2) | Comments |
| ZTE | See comment | The LS is RAN4’s reply to RAN1, and RAN1 is aware of it. As we know, this issue is under RAN1’s discussion. So we suggest to wait for RAN1’s conclusion, to us, this is out of RAN2’s scope.  |
| OPPO | Option 1 | Option 1 is clear to say what is the tempory RS.If option 2 is chosen, it is hard to associate the two burst. |
| Apple | Wait for RAN1 progress |  |
| Nokia | wait for RAN1  | This is clearly something that could be just part of TRS configuration – maybe even transparent to RAN2 configuration |
| Intel |  | Same view with ZTE |
| Samsung | Wait for RAN1 |  |
| LGE | Wait RAN1 | Agree with views to discuss later after RAN1 conclusion |
| Ericsson | Wait for RAN1 |  |
| Futurewei |  | Let RAN1 to make decision how TRS works, e.g., how the two burst would be configured and repetition is applied. RAN2 could design RRC based on RAN1 decision. |
| MediaTek | Wait for RAN1 |  |
| vivo | postpone | Need further RAN1 input for this. |
| CMCC | Wait for RAN1 |  |
| Huawei, HiSilicon | Wait for RAN1 |  |
| Qualcomm | Please see comment | Both options can be supported in the current A-TRS triggering framework. |
|  |  |  |
|  |  |  |
|  |  |  |

## ***Issue 4: UE capability for TRS based SCell activation***

TRS for SCell activation is introduced in R17, it is obvious new UE capability should be introduced to indicate whether UE support TRS for SCell activation or not.

Tempoery RS for SCell activation is one kind of TRS. The UE capability for TRS in R15 is defined as below:

CSI-RS-ForTracking ::= SEQUENCE {

 maxBurstLength INTEGER (1..2),

 maxSimultaneousResourceSetsPerCC INTEGER (1..8),

 maxConfiguredResourceSetsPerCC INTEGER (1..64),

 maxConfiguredResourceSetsAllCC INTEGER (1..256)

}

| ***csi-RS-ForTracking***Indicates support of CSI-RS for tracking (i.e. TRS). This capability signalling comprises the following parameters:- *maxBurstLength* indicates the TRS burst length. Value 1 indicates 1 slot and value 2 indicates both of 1 slot and 2 slots. In this release UE is mandated to report value 2;- *maxSimultaneousResourceSetsPerCC* indicates the maximum number of TRS resource sets per CC which the UE can track simultaneously;- *maxConfiguredResourceSetsPerCC* indicates the maximum number of TRS resource sets configured to UE per CC. It is mandated to report at least 8 for FR1 and 16 for FR2;- *maxConfiguredResourceSetsAllCC* indicates the maximum number of TRS resource sets configured to UE across CCs. If the UE includes the field in an FR1 band, it shall set the same value in all FR1 bands. If the UE includes the field in an FR2 band, it shall set the same value in all FR2 bands. The UE supports a total number of resources equal to the maximum of the FR1 and FR2 value, but no more than the FR1 value across all FR1 serving cells and no more than the FR2 value across all FR2 serving cells. The UE is mandated to report at least 16 for FR1 and 32 for FR2.The UE is mandated to report *csi-RS-ForTracking*. | Band | Yes | N/A | N/A |
| --- | --- | --- | --- | --- |

Now, it is not clear whether the new introduced temporary RS list for SCell activation will also be restricted by this UE capapbility.

**Q10: Do companies agree that temporary RS for SCell activation is also restricted by UE capability: CSI-RS-ForTracking?**

|  |  |  |
| --- | --- | --- |
| Company | Agree?(Yes/No) | Comments |
| ZTE | See comments | We think RAN1 will discuss UE capability and provide inputs to RAN2.  |
| ZTE | Yes  | Tempory RS for SCell activation is also one kind of TRS. |
| Apple | RAN1 to progress |  |
| Nokia | No (but wait RAN1) | If there is any linkage it should be informed by RAN1 – from RAN2 point of view there is no need to have any linkage. |
| Intel |  | We can further discuss it when we receive RAN1’s feature list. |
| Samsung |  | Based on RAN1 progress, we can discuss this in the next meeting. |
| LGE | Yes | Since this is another new feature to support an efficient SCell activation, additional UE capability information seems required. |
| Ericsson | Wait for RAN1 |  |
| Futurewei |  | We should get input from RAN1. Supporting TRS could be a new UE capability. RAN1 and RAN2 should discuss whether we should tie this new feature with existing CSI-RS-ForTracking capability. |
| MediaTek | Yes, but  | It is premature to discuss capability now without any RAN1 input. |
| vivo | No | If there is really any restriction, it can be detailedly defined in the new UE capability for TRS-based SCell activation. We do not prefer to stress that it is restricted by existing UE capability. |
| CMCC | Wait for RAN1 |  |
| Huawei, HiSilicon | Wait for RAN1 |  |
| Qualcomm | Please see comment | RAN1 is discussing the same issue in the UE feature list discussion. We can wait for their progress/conclusions. |
|  |  |  |
|  |  |  |
|  |  |  |

**Q11: Do companies agree that new UE capability is introduced to indicate whether UE support temporary RS for SCell activation or not?**

|  |  |  |
| --- | --- | --- |
| Company | Agree?(Yes/No) | Comments |
| ZTE | See comments | We think new capability is required, but we prefer to postpone the UE capability discussion until receives RAN1’s inputs. (So far, it is unclear whether a general capability bit is sufficient or not.)  |
| OPPO | Yes  | It is fine to leave it to RAN1. |
| Apple | Yes, new capability is needed. But details upto RAN1 |  |
| Nokia | See comment | NW needs to know if UE supports – If all R17 UEs support is fine for us but if this is not the case then one needs to have capability |
| Intel |  | We can further discuss it when we receive RAN1’s feature list. |
| Samsung |  | Based on RAN1 progress, we can discuss this in the next meeting. |
| LGE | Yes but no strong view | It is fine to leave it to RAN1. |
| Ericsson | Yes | Agree with Nokia and RAN2 can leave this to RAN1 at the moment. |
| Futurewei | Yes in principle, but | Since it is mainly L1 operations, let’s wait for RAN1 decision.  |
| MediaTek | Yes, but | There should of course new capability for this new feaure. But it is premature to discuss this without any RAN1 input. |
| vivo | Yes | New UE capability should be introduced, but we are OK to wait for further RAN1 input. |
| CMCC |  | New capability or capabilities should be introduced but details still need be further discussed. |
| Huawei, HiSilicon | Yes | We think the UE capabiltiy of TRS-based SCell activation is anyway needed, but the details should be decided in RAN1.  |
| Qualcomm | Please see comment | RAN1 is discussing the same issue in the UE feature list discussion. We can wait for their progress/conclusions. |
|  |  |  |
|  |  |  |
|  |  |  |

# Conclusions

Based on the discussion above, we propose:

# Reference

[1] [R2-2107984](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_115-e/Docs/R2-2107984.zip) MAC CE for scell activation and temporary RS Nokia, Nokia Shanghai Bell discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[2] [R2-2108450](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_115-e/Docs/R2-2108450.zip) On RAN4 LS on Temporary RS for SCell activation Huawei, HiSilicon discussion Rel-17 LTE\_NR\_DC\_enh2-Core

[3] [R2-2107021](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_115-e/Docs/R2-2107021.zip) Discussion on TRS activation for fast SCell activation OPPO discussion Rel-17 LTE\_NR\_DC\_enh2-Core