**3GPP TSG-RAN WG4 Meeting # 102-e R4-22xxxxxx**

**Electronic Meeting, February 21 – March 3, 2022**

**Agenda item:** 10.22

**Source:** Huawei, HiSilicon

**Title:** WF on R17 further Multi-RAT Dual-Connectivity enhancements

**Document for:** Approval

# Topic #1: Efficient activation/de-activation mechanism for SCells (i.e., temporary RS for efficient SCell activation)

*Note: The content marked with green highlight is what was agreed in 1st round discussion.*

## Sub-topic 1-1: Temporary RS based SCell activation delay

**Issue 1-1:****Tuncertainty\_MAC for scenario #3**

**Scenario #3: SCell to be activated belongs to FR2, if there is no active serving cell on that FR2 band, and target SCell is known to UE.**

Assuming PDCCH TCI and PDSCH TCI (when applicable) shall be associated with the triggered temporary RS burst:

if semi-persistent CSI-RS is used for CSI reporting, Tactivation\_time is 3ms + max (Ttemp\_RS+ 2ms, Tuncertainty\_SP)

if periodic CSI-RS is used for CSI reporting, Tactivation\_time is max (Ttemp\_RS + 5ms, Tuncertainty\_RRC + TRRC\_delay-THARQ)

under the condition that

One of the candidate TCI states configured in TCI-StatesPDCCH-ToAddList has the same QCL source of the triggered A-TRS,

The QCL source of CSI-RS for CQI reporting is the same as the triggered A-TRS,

The TCI state for PDCCH/PDSCH that is the same as A-TRS is assumed during SCell activation until changed by network after SCell activation.

*In the 1st round discussion, one company proposed to add one condition: UE receives the SCell activation command and TCI state activation command at the same time. Further discuss whether the additional statement is aggreeable:*

* Option 1(QC): Add one additional condition: UE receives the SCell activation command and TCI state activation command at the same time.

***Please provide further comments on the above option 1***

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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## Sub-topic 1-2: Multiple SCell activation enhancement

**Issue 1-2-1: Requirements of multiple SCell activation enhancement**

Define requirements of multiple SCell activation enhancement during maintenance stage.

**Issue 1-2-2: The NOT applicable cases for temporary A-TRS burst based multiple SCell activation enhancement, if yes for issue 1-2-1**

* + Option 1(QC, MTK, Huawei, Apple, Ericsson): the following can be a starting point.

For the following cases, temporary A-TRS burst based multiple Scell activation enhancement is not supported:

* + - Any of to-be-activated Scells triggered by one MAC-CE is unknown
      * Exceptionally, if the target FR2 Scell is unknown and if on the same band UE also has at least one parallel to-be-activated known Scell, the enhancement is supported
    - More than two SSB bursts are expected to be received/processed for the activation
    - There can be more cases to which Option 1 based enhancement is not applicable depending on RAN1 decision

*As this part would be further discussed in maintenance part, no further discussion in 2nd round in this meeting.*

**Issue 1-2-3: the applicable cases for temporary A-TRS burst based multiple Scell activation enhancement**

* + Option 1(QC, MTK, Huawei): the following can be a starting point.

Temporary A-TRS based Scell activation enhancement is applicable when more than one Scell is concurrently activated for the following cases from the legacy multiple Scell activation requirements:

* + - The cases where the requirements are TFirstSSB\_MAX\_multiple\_scells + Trs + 5ms or TFirstSSB\_MAX\_multiple\_scells + 5ms when the Scell is known and belong to FR1 and the Scell measurement cycle is equal to or smaller than 160ms.
    - The cases where the requirement is TFirstSSB\_MAX\_multiple\_scells + Trs + 5ms when the Scell is known and belongs to FR1 and the Scell measurement cycle is larger than 160ms.
    - The cases where the requirement is TFirstSSB\_MAX\_multiple\_scells + TSMTC\_MAX\_multiple\_scells+Trs +5ms when the Scell is unknown and belongs to FR1.
    - The case where the target Scell is known to UE and semi-persistent CSI-RS is used for CSI reporting.
    - The case where the target Scell is known to UE and periodic CSI-RS is used for CSI reporting.
    - The case where the target Scell is unknown to UE and semi-persistent CSI-RS is used for CSI reporting.
    - The case where the target Scell is unknown to UE and periodic CSI-RS is used for CSI reporting.
    - For the above cases, the Scell to be concurrently activated based on temporary A-TRS on one of the to-be-activated Scells shall be in the same band as the Scell where the temporary A-TRS is received.

*As this part would be further discussed in maintenance part, no further discussion in 2nd round in this meeting.*

# Efficient activation/de-activation mechanism for one SCG

## Sub-topic 2-1: Measurement requirements for deactivated SCG

**Issue 2-1-1: Min value and range for measCyclePSCell**

* + Option 1(Apple, MTK, Ericsson, Huawei, QC, Intel, Apple, OPPO): existing min value and range of measCycleSCell can be reused for measCyclePSCell (i.e., {sf160, sf256, sf320, sf512, sf640, sf1024, sf1280})
  + Option 2b (vivo): The minimum value of measCyclePSCell shall not be smaller than the minimum value of measCycleSCell, {sf640, sf1024, sf1280}
  + Option 3 (Nokia): add 40ms and 80ms, the range is {sf40, sf80, sf160, sf256, sf320, sf512, sf640, sf1024, sf1280}

***Please provide further comments on the above options.***

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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**Issue 2-1-2: Intrafrequency cell identification for deactivated PSCell**

* + Option 1 (Nokia, Apple): the following requirements for deactivated PSCell are specified:
    - Capture the proposed Time period for PSS/SSS detection, deactivated PSCell (FR1 and FR2) in section 9.2.5.1:
* **Table 9.2.5.1-x1: Time period for PSS/SSS detection, deactivated PSCell (FR1)**

|  |  |
| --- | --- |
| measCyclePSCell | TPSS/SSS\_sync\_intra |
| measCyclePSCell ≥ 40ms | Ceil(5 x Kp) x measCyclePSCell x CSSFintra |

* **Table 9.2.5.1-x2: Time period for PSS/SSS detection, deactivated PSCell (FR2)**

|  |  |
| --- | --- |
| measCyclePSCell | TPSS/SSS\_sync\_intra |
| measCyclePSCell ≥ 40ms | Ceil(Mpss/sss\_sync\_w/o\_gaps x Kp) x measCyclePSCell x CSSFintra |

* + - Capture the proposed Time period for Index detection, deactivated PSCell in section 9.2.5.1:
* **Table 9.2.5.1-x3: Time period for time index detection, deactivated PSCell (FR1)**

|  |  |
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| measCyclePSCell | TSSB\_time\_index\_intra |
| measCyclePSCell ≥ 40ms | Ceil(3 x Kp)x measCyclePSCell x CSSFintra |

* + Option 2(QC, MTK, Huawei, Ericsson, vivo): DRX configuration shall be considered

***Please provide further comments on the above options.***

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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**Issue 2-1-3: L3 measurement period on deactivated PSCell**

* + Option 2(MTK, Ericsson, Huawei, vivo, QC): specified as deactivated Scell by replacing measCycleSCell with measCyclePSCell.
  + Option 2a (QC): on top of option 2, add the following:
    - A greater number between the configured DRX for SCG and a fixed number, e.g. 320ms, replaces it for measurement relaxation while the SCG is deactivated
  + Option 3(Nokia, Apple): specified as deactivated Scell by replacing measCycleSCell with measCyclePSCell. **However only measCyclePScell applies and configured DRX for activated state is not applicable.**

One example (in below) is given for option 3 where requirements for DRX are not applicable herein:

Table 9.2.5.2-y1: Measurement period for intra-frequency measurements without gaps (deactivated PSCell) (FR1)

|  |  |
| --- | --- |
| measCyclePSCell | T SSB\_measurement\_period\_intra |
| measCyclePSCell ≥ 40ms | Ceil(5 x Kp)x measCyclePSCell x CSSFintra |

***Please provide further comments on the above options.***

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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**Issue 2-1-4: L3 measurement on deactivated Scell in deactivated SCG**

* + Option 1(QC): measCycleSCell is replaced by max(measCyclePSCell, measCycleSCell)
  + Option 2 (MTK, Nokia, Huawei, Apple, Ericsson, vivo): use the legacy SCell measurement requirement.

***Recommended WF: agree on option 2.***

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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## Sub-topic 2-2: SCG Activation/deactivation delay

**Issue 2-2-1: UE processing time (Tprocessing) in PSCell activation delay**

**GTW session (February 24, 2022)**

* Agreements
  + When PSCell is activated from deactivated state
    - If any PSCell parameter is modified
      * Tprocessing = [20ms].
    - Otherwise
      * Tprocessing = [5 or 10ms].
    - Note: further discuss if Tprocessing or a different term shall be used

***Further discuss below in 2nd round***

* + When PSCell is activated from deactivated state
    - If any PSCell parameter is modified
      * Tprocessing = [20ms].
    - Otherwise
      * Option 1: Tprocessing = 5 ms.
      * Option 2: Tprocessing = 10ms.
    - Note: further discuss if Tprocessing or a different term shall be used

***Please provide further comments on the above options.***

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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**Issue 2-2-2: time/frequency tracking time (T∆) in PSCell activation delay**

*Majority companies can agree on option 1. One company supports option 3.*

*No tentative agreement.*

*Candidate options:*

* + Option 1 (QC, MTK, Nokia, Huawei, Apple, OPPO, vivo): time/frequency tracking time (T∆) in PSCell activation delay is needed, and T∆ = 1\*Trs for both RACH-based and RACH-less cases.
  + Option 3 (Ericsson):
    - T∆ = 0 if RLF/BFD configured, otherwise T∆ = 1\*Trs for RACH-based activation
    - RACH-less activation, as the precondition for RACH-less activation is always have the RLM/BFD configured, there is no need to keep T∆.

**Recommendations WF：**

**Agree on option 1.**

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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**Issue 2-2-3: whether Tsearch is needed for RACH-less based PSCell activation delay**

**GTW session (February 24, 2022)**

* Agreements
  + Case 1: RLM and BFD are configured and no failure is detected
    - Option 1A
      * Tsearch = 0 ms if the target cell is ‘known’
      * Tsearch = [X] ms if the target cell is ‘unknown’
    - Option 1B:
      * Tsearch = 0 ms provided that TBD side conditions are fulfilled
  + Case 2: RLM and BFD are not configured
    - Tsearch is FFS
  + Note: whether Case 2 shall be supported may be revisited based on RAN2 decision

***Further discuss below in 2nd round***

* + Case 1: RLM and BFD are configured and no failure is detected
    - Option 1A
      * Tsearch = 0 ms if the target cell is ‘known’
      * Tsearch = [X] ms if the target cell is ‘unknown’
    - Option 1B:
      * Tsearch = 0 ms provided that TBD side conditions are fulfilled

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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* + Case 2: RLM and BFD are not configured
    - Option 1: Tsearch is needed
  + Note: whether Case 2 shall be supported may be revisited based on RAN2 decision

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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**Issue 2-2-4: Conditions for RACH-less based SCG activation**

**Background**

The TA related condition was agreed in last meeting [R4-2204633]. The following discussion focus on the 2nd and 3rd bullets.

|  |
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| **Issue 2-2-6: Conditions for RACH-less based SCG activation**   * Agreements   + RACH-less based SCG activation delay requirements shall meet the following conditions:   - TAT is running and TA is regarded as valid,  - FFS: TCI state is known for both UE and network,  - FFS: BFD should be configured and no BF is detected. |

* + Option 2(MTK, vivo): RACH-less based SCG activation delay requirements shall meet the following conditions:

- BFD should be configured and no BF is detected.

* + Option 3 (QC, Nokia, Huawei, Apple, Ericsson): as the conditions of RACH-less PSCell activation would be explicitly defined in RAN2, RAN4 not to discuss this.

***Please provide further comments on the above options.***

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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**Issue 2-2-5: Known condition for TCI state at deactivated PSCell**

The known condition for a TCI state at RACH-less SCG activation is “BFD for the TCI state is configured and no BF is detected for the TCI state”.

**Issue 2-2-6: known condition for PSCell activation**

*Background*

The known condition was agreed in last meeting [R4-2204633].

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| In FR1 and FR2, the PSCell is known if it has been meeting the following conditions:  - During the last 5 seconds before the reception of the PSCell activated command:  - the UE has sent a valid measurement report for the PSCell being activated and  - One of the SSBs measured from the PSCell being activated remains detectable according to the cell identification conditions specified in clause 9.3.  - One of the SSBs measured from PSCell being activated also remains detectable during the PSCell activated delay Tconfig\_PSCell according to the cell identification conditions specified in clause 9.3.  otherwise it is unknown. |

* Proposals
  + Option 1(Nokia): add a condition on top of the conditions agreed in last meeting:
    - If configured to perform RLM on the deactivated PSCell, RLF has not been detected.
  + Option 2 (MTK, Apple, OPPO, Ericsson, vivo): don’t add the condition proposed in option1.

***Please provide further comments on the above options.***

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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**Issue 2-2-7: Requirements for PSCell activation delay**

*During 1st round discussion, 6 companies prefer to discuss RACH-based and RACH-less separately. One company prefer to define one generic PSCell delay requirement covering both RACH-based and RACH-less.*

* + Option 1(Nokia): Define one generic PSCell activation delay requirement covering both RACH based and RACH less PSCell activation delay, where the PSCell activation delay requirement differentiation between RACH-based and RACH-less will be accounted by the parameter TPSCell\_ DU.

*From moderator’s view, technically RACH-less and RACH-based have many different aspects. As this is the last meeting for core part completion, Moderator suggest not to further discuss this and focus on detailed requirements definition.*

Discuss RACH-based and RACH-less PSCell activation delay separately, and focus on detailed requirements definition.

***With the above clarification, check Nokia’s view whether the above yellow highlight is acceptable.***

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
| Nokia |  |

**Issue 2-2-8: Direct SCG activation for multiple cells (PSCell+SCell(s))**

Define requirements for SCG activation with multiple cells (PSCell+Scell(s)) during maintenance stage.

## Sub-topic 2-3: Interruption requirements

**Issue 2-3-1: Baseline for interruption due to PSCell activation/deactivation**

If PSCell is activated from a deactivated status

* + Option 1(Nokia, Ericsson): Existing requirements for interruption due to Scell activation/deactivation can be used as a baseline.
  + Option 2 (QC, MTK, Huawei, Apple, vivo): Existing requirements for interruption due to PSCell addition/release can be used as baseline, i.e., 1ms interruption length.

***Please provide further comments on the above options.***

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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**Issue 2-3-2: interruption due to PSCell activation/deactivation in asynchronous deployment.**

* + Option 1 (Nokia, Ericsson)

For SCG activation/deactivation in ENDC,

When SCG is activated (i.e., PSCell is activated), there are no active serving cells in the SCG. The interruption on LTE MCG can refer to clause 7.32.2.5 (Interruptions at SCell activation/deactivation) in TS 36.133.

For SCG activation/deactivation in NR-DC, the interruption requirements can refer to existing interruptions at activation/deactivation specified in clause 8.2.4.2.2 in TS38.133, where sync and async scenario has different interruption length.

* + Option 2 (MTK, Huawei, Apple, vivo):

For SCG activation/deactivation in ENDC,

-When SCG is activated/deactivated, there are no active serving cells in the SCG. The interruption on LTE MCG can refer to clause 7.32.2.4 (Interruptions at Scell addition/release) in TS 36.133.

For SCG activation/deactivation in NR-DC, the interruption requirements can refer to existing interruptions at PSCell addition/release specified in clause 8.2.4.2.1 in TS38.133.

***Please provide further comments on the above options.***

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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**Issue 2-3-3: Interruption due to L3 measurement on deactivated PSCell**

* + If RLM/BFD is not configured, the current interruption requirement during measurements on deactivated inter-band SCC applies.
  + If RLM/BFD is configured, the current interruption requirement during Scell **dormancy** applies ([1]%).

**Issue 2-3-4: Interruption requirement due to RLM and BFD on deactivated PSCell**

* + Option 1 (QC, Intel, MTK, Nokia, Huawei, Apple, vivo): The same principle as the interruption due to Scell **dormancy** is applied ([0.5]%).
  + Option 2 (Ericsson): Interruption requirements due to RLM/BFD during deactivated SCG should consider measCyclePSCell (e.g. when the configured measCyclePSCell is 640 ms or longer, 0.5% probability of missed ACK/NACK is allowed).

**Recommendations WF：**

**Agree on option 1.**

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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## Sub-topic 2-4: RLM/BFD/BFR/Beam management on deactivated PSCell

**Issue 2-4-1: Whether RLM/BFD delay requirements on deactivated PSCell can be relaxed**

* + Option 1 (QC, Nokia, Huawei, Apple, Ericsson): Yes, use the parameter measCyclePSCell to the RLM/BFD requirements on deactivated PSCell.
  + Option 1a (QC): on top of option 1, add the following:
    - A greater number between the configured DRX for SCG and a fixed number, e.g. 320ms, replaces it for measurement relaxation while the SCG is deactivated
  + Revised Option 2 (vivo):

-If the min value of measCyclePSCell can be to 320ms or 640ms, there is no need to have further relaxation here.

-If the min value of measCyclePSCell less than 320ms, 2 times relaxation on RLM/BFD measurement of the deactivated PSCell.

***Please provide further comments on the above options.***

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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## Sub-topic 2-5: Others

**Issue 2-5-1: whether UE shall meet the existing Te and Tq when PSCell is deactivated**

*Note: This issue is not for first transmission when deactivated PSCell is activated. The first transmission issue is issue 2-5-2.*

* + Option 1 (MTK, Huawei, Apple, vivo): Timing requirements including Te and Tq don’t need to be specified when PSCell is deactivated.
  + Option 2(Ericsson): The existing UE initial transmit timing error (Te) and Tq requirements are met at least until the TAT is running.

***Recommended WF:***

***Agree on option 1.***

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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**Issue 2-5-2: whether UE shall meet the existing Te requirement for the first transmission of RACH-less based SCG activation on PSCell**

The existing Te requirement applies for the first transmission of RACH-less based SCG activation on PSCell.

**Issue 2-5-3: If the answer of issue 2-5-1 and/or issue 2-5-2 is yes, conditions for meeting Te requirements**

* SSB should be available at the UE once every 160 ms, or
* FFS: SSB should be available at the UE with the same rate with which the UE performs RRM requirements on PSCell once every measCyclePSCell.

***Please provide further comments on the second bullet.***

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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**Issue 2-5-4: UE behaviour upon RLF and BFD on deactivated PSCELL**

* + Option 1 (Ericsson):
    - The UE shall stop performing RLM on the deactivated PSCell upon detecting RLF on the deactivated PSCell.
    - The UE shall not perform beam failure recovery or candidate beam detection upon beam failure detection on the deactivated PSCell.
    - The UE shall stop performing beam failure detection if the UE has detected beam failure on the deactivated PSCell.
  + Option 2(QC, MTK, Nokia, Huawei, Apple,vivo): The UE behaviours upon RLF and BFD on deactivated PSCell belongs to the scope of RAN2

**Recommendations WF：**

**Agree on option 2.**

***(The below table is to be moved to 2nd round summary and removed in the formal WF)***

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| **Company** | **Comments** |
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# Work split

As the below requirements are agreed to be developed in maintenance phase, the work split is provided. Please add your name on the topic you are interested in, thank you in advance.

* requirements of multiple SCell activation enhancement (discussed in topic #1)
* requirements for SCG activation with multiple cells (PSCell+Scell(s)) (discussed in topic #2)

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|  | **Responsible company** | **Comments** |
| **Temporary RS based SCell activation** | | |
| A-TRS based SCell activation and deactivated delay requirements with multiple downlink SCells |  | Both activation and deactivation delay shall be considered |
| Interruptions at A-TRS based SCell activation/deactivation with multiple downlink SCells |  | There are both TS 38.133 and TS 36.133 CRs |
| **Efficient activation/de-activation mechanism for one SCG** | | |
| SCG activation delay with PSCell and SCell (s) |  |  |
| Interruptions due to SCG activation with PSCell and SCell (s) |  | There are both TS 38.133 and TS 36.133 CRs |  |