3GPP TSG-RAN WG2 Meeting #105 R2-190xxxx

Athens, Greece, February 25th-March 1st 2019

Agenda Item: 10.4.1.4.1

Source: MediaTek Inc.

**Title: Discussion on timing reference cell in SMTC configuration**

Document for: Discussion and decision

# 1 Introduction

This is report for the following discussion.

[R2-1900910](file:///C:\Data\3GPP\Extracts\R2-1900910%2038.331%20CR0877%20Correction%20on%20smtc%20configuration%20in%20NR%20SCell%20addition%20procedure.docx) Correction on smtc configuration in NR SCell addition procedure MediaTek Inc. CR Rel-15 38.331 15.4.0 0877 - F NR\_newRAT-Core

- Ericsson think the only case not covered by the current spec EN-DC with LTE HO and PSCell addition and SCell addition.

- Qualcomm think source or target is very confusing. We need to be very clear about the scenarios.

- Samsung think this change would require UE to acquire timing of the SCell from the SCell. Don't see a problem with the current spec.

=> Update the field description to separate the addition case from the handover with addition case. Can also discuss offline whether to change the current timing reference from source to target. Related case of LTE handover (EN-DC case) can also be discussed (R2-1900911)

* => Revised in R2-1902592 (Offline discussion 38)

[105#10][NR] smtc configuration in NR mobility procedures (MediaTek)

Intended outcome: Agreed CRs to 36.331 and 38.331

Deadline: Thursday 2019-03-07

# 2 Discussion

## 2.1 Background

In NR mobility procedure, the network could (optionally) provide SMTC configuration and UE could use this information to find the target cell. The SMTC configuration is based SFN and timing offset of a reference cell. So, RRC specification has to clearly define which timing reference cell to use.

### 2.1.1 NR PSCell addition and SN Change (EN-DC)

For PSCell addition and SN Change (EN-DC) procedure, the SMTC configuration is provided in LTE RRC message *RRCConnetionReconfiguration* (inside the IE *RRCConnectionReconfiguration-v1530-IEs*)

| *RRCConnectionReconfiguration* field descriptions |
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| ***smtc***  The SSB periodicity/offset/duration configuration of target cell for NR PSCell addition and SN change. It is based on timing reference of EUTRAN PCell. If the field is absent, the UE uses the SMTC configured in the *measObjectNR* having the same SSB frequency and subcarrier spacing. |

Currently, it is specified that the timing reference cell is EUTRAN PCell. However, the PSCell addition or SN Change procedure could be trigger by network together with LTE handover procedure. In this case, it is unclear whether the timing reference cell is source EUTRAN PCell or target EUTRAN PCell.

**Observation 1: In case LTE handover is triggered together with SN Change or NR PSCell addition procedure, it is unclear that whether the timing reference cell is source EUTRAN PCell or target EUTRAN PCell.**

**Question 1: Does company agree the observation 1?**

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| **Company** | **Yes/no** | **Comments** |
| MediaTek | Yes |  |
| Ericsson | Yes | We agree that it is not clear from the UE point of view whether to use the source PCell or the target PCell. |
| ZTE | Yes |  |
| Intel | Yes | Agree it needs to clarify in the LTE spec whether to use the source or the target LTE PCell as the timing reference for the smtc signalled in the LTE RRC Connection Reconfiguration message. |
| Huawei | Yes | This is not specified now. However, in many cases, there will be a MO for the added or target NR PSCell so that this field doesn't need to be provided. |
| Qualcomm Incorporated | Yes | From the UE point of view, the question is if the UE can perform LTE procedure and NR procedure concurrently, i.e. the timing reference is the source cell, or perform LTE procedure first and then NR procedure sequentially, i.e. the timing reference is the target cell.  We believe the first option is efficient in terms of mobility performance. |
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### 2.1.2 NR SCell addition (For both EN-DC and NR SA)

For NR SCell addition procedure, the SMTC configuration is provided in NR RRC message *RRCReconfiguration* (inside the IE SCellConfig). Note that this NR RRC message could be embedded in LTE *MobilityFromEUTRACommand or* LTE *RRCConnetionReconfiguration*).

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| *SCellConfig* field descriptions |
| ***smtc***  The SSB periodicity/offset/duration configuration of target cell for NR SCell addition. The network sets the *periodicityAndOffset* to indicate the same periodicity as *ssb-periodicityServingCell* in *sCellConfigCommon*. The *smtc* is based on the timing reference of (source) SpCell of associated cell group. If the field is absent, the UE uses the SMTC configured in the *measObjectNR* having the same SSB frequency and subcarrier spacing. |

The network could trigger NR SCell additional procedure together with inter-RAT handover from LTE to NR. In this case, it is unclear that what does “(source) SpCell of associated cell group”. Does this mean the (source) LTE PCell or the (target) NR PCell.

**Observation 2: In case inter-RAT handover from LTE to NR is triggered together with NR SCell addition procedure, it is unclear that whether the timing reference cell is source EUTRAN PCell or target NR PCell.**

**Question 2: Does company agree the observation 2?**

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| **Company** | **Yes/no** | **Comments** |
| MediaTek | Yes |  |
| Ericsson | Yes | Same comments as above. |
| ZTE | Yes |  |
| Huawei | Yes |  |
| Qualcomm Incorporated | Yes |  |
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The network could trigger NR SCell additional procedure together with intra-NR handover (NR SA) or PSCell change (EN-DC). In this case, the timing reference cell is the source PCell or source PSCell. However, the handover command is actually generate by the target gNB. So, this means that the target gNB has to know the timing of source sPCell in order to include the SMTC configuration in the RRC message.

**Observation 3: In case intra-NR handover or PSCell change is triggered together NR SCell addition procedure, the target gNB has to know the timing of source sPCell in order to include the SMTC configuration for NR SCell addition.**

**Question 3: Does company agree the observation 3?**

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| **Company** | **Yes/no** | **Comments** |
| MediaTek | Yes |  |
| Ericsson | Yes | This will be mostly known as the target cell as this information is needed if the target has to include the SMTC information in the reconfigurationWithSync while performing blind handovers. So, we do not think this is a severe issue.  However, in principle we agree that it would have been good to include target cell’s timing reference. But, changing the UE behaviour for a feature that is already supported in the current specification is not good.  But we are fine with any proposed changes if all the UE vendors are happy 😊. |
| ZTE | Yes | So far, for intra-NR handover, the target gNB has to know the timing of source PCell for generating the SMTC for target PCell, and indicate it in reconfigurationWithSync. |
| Intel | Yes | I think the current text is only for PSCell change. So it makes sense from that case. For intra-NR handover, I think some clarifications are needed. |
| Huawei | Yes | In our understanding, it is helpful for the UE to have such information. However, in most cases, there will be a MO configured by the source NR PSCell so that this field will be omitted. |
| Qualcomm Incorporated | Yes |  |
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## 2.2 Issue #1: NR PSCell Addition and SN Change (For EN-DC)

Related to observation 1,

* In case LTE handover is triggered together with SN Change or NR PSCell addition procedure, it is unclear that whether the timing reference cell is source EUTRAN PCell or target EUTRAN PCell.

**Question 4: If companies agree observation 1, which timing reference cell should be used for joint LTE handover and NR PSCell addition procedure?**

* **Option 1 : Source EUTRA PCell**
* **Option 2 : Target EUTRA PCell**

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| **Company** | **Options** | **Comments** |
| MediaTek | 2 | As the handover command is generated by the target cell, we think it is more reasonable to use target PCell as timing reference cell. But as comment by some network vendors, the network implementation could also provide this SMTC based on source cell timing. So, we don’t have strong view on which option to go. However, we do think this should be clear in the specification to avoid any IOT issue. |
| Ericsson | 2 | On the proposed text below, we have some changes.  ***smtc***  The SSB periodicity/offset/duration configuration of target cell for NR PSCell addition and SN change. If EUTRAN PCell is changed within the same *RRCConnectionReconfigruation* message (i.e. intra-LTE handover), it is based on timing reference of target EUTRAN PCell. For all other cases, it is based on timing reference of EUTRAN PCell. If the field is absent, the UE uses the SMTC configured in the *measObjectNR* having the same SSB frequency and subcarrier spacing. |
| ZTE | 2 | On the proposed text change, we prefer the version from Ericsson by changing “target cell” into “target NR PSCell” in the first sentence. The original “target cell” is a bit misleading. |
| Intel | 2 |  |
| Huawei | No strong view | But we would like to understand whether the UE actually uses the offset, and if so, how.  [MediaTek] The SMTC configuration provides the SFN and timing offset of target SSB based on a timing reference cell. The offset is critical in UE implementation as the UE will expect the SSB is transmitted in the corresponding time location calculated by offset value. If the offset value is misinterpreted by the UE, the UE may search SSB in wrong time location and result in synchronisation error of target cell. |
| Qualcomm Incorporated | 2 | This looks in line with intended network behaviour. But backward compatibility should be carefully assessed. |
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The (tentative) proposed change is to clarify this in field description as below.

| *RRCConnectionReconfiguration* field descriptions |
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| ***smtc***  The SSB periodicity/offset/duration configuration of target NR PSCell ~~cell~~ for NR PSCell addition and SN change. It is based on timing reference of EUTRAN PCell. If EUTRAN PCell is changed within the same *RRCConnectionReconfigruation* message (i.e. intra-LTE handover), it is based on timing reference of target EUTRAN PCell. If the field is absent, the UE uses the SMTC configured in the *measObjectNR* having the same SSB frequency and subcarrier spacing. |

**Proposal 1:**

## 2.3 Issue #2: NR SCell Addition (For both EN-DC and NR SA)

Related to observation 2,

* In case inter-RAT handover from LTE to NR is triggered together with NR SCell addition procedure, it is unclear that whether the timing reference cell is source EUTRAN PCell or target NR PCell.

**Question 5: If companies agree observation 2, which timing reference cell should be used for joint LTE handover and NR SCell addition procedure?**

* **Option 1 : Source EUTRAN PCell**
* **Option 2 : Target NR PCell**

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| **Company** | **Options** | **Comments** |
| MediaTek | 2 | It seems strange to use EUTRAN PCell as timing reference cell in this case. |
| Ericsson | 2 | Similar to the comment made in previous question. |
| ZTE | 2 |  |
| Intel | 2 | Using the logic that the original text is for PSCell change, the timing reference should still be the NR PCell for SCell addition |
| Huawei | No strong view | But we would like to understand whether the UE actually uses the offset, and if so, how.  [MediaTek] Same comment as above question. |
| Qualcomm Incorporated | 2 | But such change can be NBC depending on how the UE or the network is implemented. |
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Related to observation 3,

* In case intra-NR handover or PSCell change is triggered together NR SCell addition procedure, the target gNB has to know the timing of source sPCell in order to include the SMTC configuration for NR Scell addition.

**Proposal 2:**

**Question 6: If companies agree observation 3, do you think that we should change the timing reference cell from source NR sPCell to target NR sPCell.**

* **Option 1 : Do nothing**
* **Option 2 : Change timing reference from source to target**

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| **Company** | **Options** | **Comments** |
| MediaTek | 1 or 2 | For Scell addition, it is unclear why the timing reference cell is source cell. As the handover command is generated by the target cell, we think it is more reasonable to use target PCell as timing reference cell. But as comment by some network vendors, the network implementation could also provide this SMTC based on source cell timing. In addition, some compnies have strong concern on the NBC change. So, we are also fine to go option 1. (maybe even prefer option 1). |
| Ericsson | 1 or 2 | As mentioned in comments of question-3, we think that the target cell will not perform blind Scell addition if it is not aware of the source SPCell’s timing difference with itself. Therefore, we think we need not change the specification at this late stage for this feature.  However, we also agree that having a uniform UE behaviour for all cases would be ideal. If the UE vendors are okay to change the timing reference for newly added Scells from source cell to the target cell at the time of NR Pcell change or the NR SpCell change, then we are okay with it as well. |
| ZTE | 2 | We prefer to have a uniform UE behaviour for Scell addition upon intra-NR handover and inter-RAT handover(from LTE to NR). |
| Intel | 2 | The existing text is for the PSCell change case. So for this case the existing text seems correct. In the case of intra-NR handover, it has to be the target NR Pcell, but then it can be also based on the source NR Pcell if the source timing is known to the target gNB.  However, we would prefer to align the inter-RAT handover from LTE to NR, intra-NR handover and PSCell change for simplicity. Anyway, Scell will start deactivated. |
| Huawei | 1 | There is no problem and 2 is non-backward compatible. As said before, we should understand whether the UE actually uses the offset and how. |
| Qualcomm Incorporated | 2 | This looks in line with intended network behaviour. But backward compatibility should be carefully assessed. |
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**Proposal 3:**

The (tentative) proposed change is to clarify this in field description as below.

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| *SCellConfig* field descriptions |
| ***smtc***  The SSB periodicity/offset/duration configuration of target cell for NR SCell addition. The network sets the *periodicityAndOffset* to indicate the same periodicity as *ssb-periodicityServingCell* in *sCellConfigCommon*. The *smtc* is based on the timing reference of ~~(source)~~ SpCell of associated cell group. For inter-RAT handover to NR, the timing reference cell is the target NR PCell. For intra-NR PCell change (NR standalone), the timing reference cell is the target PCell. For NR PSCell change (EN-DC), the timing reference cell is the target NR PSCell. If the field is absent, the UE uses the SMTC configured in the *measObjectNR* having the same SSB frequency and subcarrier spacing. |

[Huawei] In the CR about "reconfiguration with sync", "intra-NR handover" is changed to "intra-NR PCell change", so we should not add "intra-NR handover". The other modifications is to make things clearer. Still, for intra-NR PCell change, the proposal is non-backward compatible, so we do not support it.

## 2.4 Backward compatible issue for the proposed changes

According to the discussion in 2.2 and 2.3, we may clarify or change the timing reference cell in SMTC configuration for the following 3 procedure.

1. SMTC for NR PSCell in intra-LTE handover with NR PSCell addition procedure
2. SMTC for NR SCell in inter-RAT LTE handover to NR with NR SCell addition procedure
3. SMTC for NR SCell in intra-NR handover with NR SCell addition procedure

During the online/offline discussion, some companies express the concern on backward compatibility for above 3 changes. It is discussed that weather we should add capability to solve the backward compatible issues.

**Question 7: Do you think that we should add capability for above changes? If yes, how to add this capability? If no, why? Please provide your view from backward compatibility aspect.**

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| **Company** | **Yes/no** | **Comments** |
| MediaTek | no | For case A and B, the current specification is unclear. There are already inter-operability issues between legacy network and legacy UE. We understand that there would still be compatibility issues if only the network or UE is implemented according to the changes. But the changes do not introduce new IOT issues to legacy network or UE. Considering that, we think that it is not necessary to add capability. We also don’t think that adding new capability could solve the problem since only new network will understand the new capability bits.  For case C, we agree that the current behaviour is clear and it is a NBC change. The change creates new IOT issues if only the network or the UE is implemented according to the CR. So, maybe we should not have this change at all. On the other hand, if all companies agree the NBC change, new capability is not help either. The legacy network will still configure the SMTC based on old specification even if new UE report the new capability. |
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# 3 Conclusions

Base on the discussion in section 2, we have the following observations and proposals:

**Proposal 1:**