**3GPP TSG-RAN WG4 Meeting #94-e R4-20xxxxx**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item:** 8.15.1.1, 8.15.1.3, 8.15.1.6

**Source:** ZTE

**Title:** Email discussion summary for RAN4#94e\_#63\_NR\_RRM\_Enh\_RRM\_Part\_2

**Document for:** Information

# Introduction

The scope of this email discussion summary covers following agenda items.

8.15.1.1 SRS carrier switching requirements

8.15.1.3 CGI reading requirements with autonomous gap

8.15.1.6 Mandatory MG patterns

The sub topics for agenda 8.15.1.1 SRS carrier switching requirements are

* Applicability of NR SRS carrier switching time
* SRS carrier switching interruption requirements
* Impact to RRM measurement requirements due to SRS carrier switching

The candidate target of this email discussion for 1st round is to collect comments from companies on the open issues. The scope of 2nd round and necessity of CR depending on outcome of 1st round.

The sub topics for agenda 8.15.1.3 CGI reading requirements with autonomous gap are

* Known cell condition for CGI reading
* Delay requirements for CGI reading
* Interruption requirements for CGI reading
* Requirements structure

The candidate target of this email discussion for 1st round is to collect comments from companies on the open issues. The scope of 2nd round and necessity of CR depending on outcome of 1st round.

The sub topics for agenda 8.15.1.6 Mandatory MG patterns are

* UE capability and applicability of additional mandatory measurement gaps
* Mandatory MG patterns for Rel-16

The candidate target of this email discussion for 1st round is to collect comments from companies on the topic. The scope of 2nd round depending on outcome of 1st round.

# Topic #1: SRS carrier switching requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2000658](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000658.zip) | Nokia, Nokia Shanghai Bell | Proposal1: The applicability of SRS carrier switching time shall be explicitly defined in RAN4 spec: * 200us SRS carrier switching time applies to intra-band CA in both FR1 and FR2.
* 200us, 500us and 900us SRS carrier switching time apply to inter-band CA in FR1 and between FR1 and FR2.

Proposal2: A LS shall be sent to RAN2 informing the applicability of the SRS carrier switching time.Proposal3: The interruption requirements shall be defined dependent on the numerologies of both SwitchTo and SwitchFrom or interrupted cells.Proposal4: The Maximum Receive Timing Difference (MRTD) shall be considered when deriving the interruption requirements. Proposal5: It is proposed to define the interruption requirements for intra-band CA as:The interruption on PCell and each of the activated SCells during the switching to the PUSCH-less SCell shall not exceed X1 slots including the first slot where SRS transmission is configured on the PUSCH-less SCell.The interruption on PCell and each of the activated SCells during the switching from the PUSCH-less SCell shall not exceed X1 slots including the last slot where SRS transmission is configured on the PUSCH-less SCell.Where X1 is defined in Table 1 and Table 2 for FR1 and FR2 respectively. Table 1. Interruptions (X1 #slots) at SRS carrier switching for intra-band CA in FR1Table 2. Interruptions (X1 #slots) at SRS carrier switching for intra-band CA in FR2Proposal6: It is proposed to define the interruption requirements for inter-band CA as:The interruption on PCell and each of the activated SCells during the switching to the PUSCH-less SCell shall not exceed X2 slots including the first slot where SRS transmission is configured on the PUSCH-less SCell.The interruption on PCell and each of the activated SCells during the switching from the PUSCH-less SCell shall not exceed X2 slots including the last slot where SRS transmission is configured on the PUSCH-less SCell.Where X2 is defined in Table 4 for inter-band CA within FR1 and inter-band CA between FR1 and FR2. Table 4. Interruptions (X2 #slots) at SRS carrier switching for inter-band CA within FR1 and inter-band between FR1 and FR2Proposal7: For FR1+FR1 EN-DC, the interruption on LTE serving cells due to NR SRS carrier switching is defined as:The interruption on PCell and each of the activated SCells in MCG during the switching to the PUSCH-less SCell shall not exceed Y subframes including the first subframe where SRS transmission is configured on the PUSCH-less SCell.The interruption on PCell and each of the activated SCells in MCG during the switching from the PUSCH-less SCell shall not exceed Y subframes including the last subframe where SRS transmission is configured on the PUSCH-less SCell. Where Y is defined in Table 5.Proposal8: For FR1+FR2 EN-DC, there is no interruption on LTE serving cells due to NR SRS carrier switching.Proposal9: The interruption on LTE serving cells due to NR SRS carrier switching in NE-DC is defined as:The interruption on PSCell and each of the activated SCells in SCG during the switching to the PUSCH-less SCell shall not exceed Y subframes including the first subframe where SRS transmission is configured on the PUSCH-less SCell.The interruption on PSCell and each of the activated SCells in SCG during the switching from the PUSCH-less SCell shall not exceed Y subframes including the last subframe where SRS transmission is configured on the PUSCH-less SCell. Where Z is defined in Table 5.Table 5. Interruptions (Y #subframes) on LTE serving cells at NR SRS carrier switching for EN-DC and NE-DC Proposal10: For FR1+FR1 EN-DC, the interruptions on NR serving cells due to LTE SRS carrier-based switching is defined as:The interruption on PSCell and each of the activated SCells in SCG during the switching to the PUSCH-less SCell shall not exceed X3 slots including the first slot where SRS transmission is configured on the PUSCH-less SCell.The interruption on PSCell and each of the activated SCells in SCG during the switching from the PUSCH-less SCell shall not exceed X3 slots including the last slot where SRS transmission is configured on the PUSCH-less SCell. Where X3 is defined in Table 6.Proposal11: For FR1+FR2 EN-DC, there is no interruption on NR serving cells due to LTE SRS carrier switching.Proposal12: The interruptions on NR serving cells due to LTE SRS carrier-based switching in NE-DC is defined as:The interruption on PCell and each of the activated SCells in MCG during the switching to the PUSCH-less SCell shall not exceed X3 slots including the first slot where SRS transmission is configured on the PUSCH-less SCell.The interruption on PCell and each of the activated SCells in MCG during the switching from the PUSCH-less SCell shall not exceed X3 slots including the last slot where SRS transmission is configured on the PUSCH-less SCell. Where X3 is defined in Table 6.Table 6. Interruptions (X3 #slots) on NR serving cells at LTE SRS carrier-based switching for EN-DC and NE-DCProposal13: The interruptions on LTE serving cells due to LTE SRS carrier-based switching in EN-DC ad NE-DC is defined as:The interruption on PCC and each of the activated SCCs during the switching to the PUSCH-less SCC shall not exceed 2 subframes including the first subframe where SRS transmission is configured on the PUSCH-less SCC.The interruption on PCC and each of the activated SCCs during the switching from the PUSCH-less SCC shall not exceed 2 subframes including the last subframe where SRS transmission is configured on the PUSCH-less SCC. |
| [R4-2001033](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001033.zip) | MediaTek inc. | Observation 1: RAN1 had agreed that SRS carrier switching shall avoid the collision with SSB and CORSETs.Observation 2: In EN-DC/NE-DC, from network’s view, owing to no effective coordinate mechanism, it’s very hard to avoid the NR SRS carrier switching configuration from one CG to collide with LTE measurement in the other CG.Proposal 1: Define carrier-based SRS switching interruption in FR2 base on 200us RF transition time only.Proposal 2: Define carrier-based SRS switching interruption both in intra-band and inter-band.* Intra-band, the interruption shall be 200us+6 SRS symbols
* Inter-band, the interruption shall be 200us, 500us, 900us+6 SRS symbols for FR1 and 200us+6 SRS symbols for FR2

Proposal 3: SRS Carrier switching shall avoid the collision with SSBs or RSs for any L1 measurements.Proposal 4: The SRS carrier switching interruption requirement from NR to LTE is shown as follow.Table 1. Interruption length (subframes) due to SRS carrier switching

|  |  |  |
| --- | --- | --- |
| InterruptionLength(subframes) | RF transition time(us) | Aggressor cell SCS (kHz) |
| 15 | 30 | 60 | 120 |
| Victim Cell | 200 | 2 | 2 | 2 | 2 |
| 500 | 2 | 2 | 2 | 2 |
| 900 | 3 | 3 | 3 | 2 |

Proposal 5: The SRS carrier switching interruption from LTE to NR is shown as follow.Table 2. Interruption length (slots) due to SRS carrier switching

|  |  |
| --- | --- |
| Victim Cell SCS(KHz) | Interruption Length (slot)  |
| 15 | 2 |
| 30 | 3 |
| 60 | 5 |
| 120 | 9 |

Proposal 6: When SRS carrier switch from carrier 1 to carrier 2 in one CG, the UE shall drop the measurement for the other CG and there is also an interruption for other CG’s reception and transmission. |
| [R4-2001275](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001275.zip) | ZTE | Proposal 1. All of the SRS carrier switching time is applicable for both FR1 and FR2.Proposal 2. Interruption length on NR victim cells during NR SRS carrier switching in EN-DC, NE-DC, NR-DC and SA operation is as in Table 1.Table 1. Interruption length on NR victim cell during NR SRS carrier switching

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | SRS carrier switching time (us) | Interruption length X (slots) |
| Sub carrier spacing for agressor cell (kHz) |
| 15 | 30 | 60 | 120 |
| 0 | 1 | 200 | 2 | 2 | 2 | 2 |
| 500 | 2 | 2 | 2 | 2 |
| 900 | 3 | 3 | 3 | 2 |
| 1 | 0.5 | 200 | 3 | 2 | 2 | 2 |
| 500 | 3 | 3 | 3 | 3 |
| 900 | 4 | 4 | 4 | 3 |
| 2 | 0.25 | 200 | 4 | 3 | 3 | 3 |
| 500 | 5 | 4 | 4 | 4 |
| 900 | 7 | 6 | 6 | 5 |
| 3 | 0.125 | 200 | 7 | 5 | 4 | 4 |
| 500 | 9 | 7 | 6 | 6 |
| 900 | 12 | 10 | 10 | 9 |

Proposal 3. In EN-DC, NE-DC, interruption length on LTE victim cells during NR SRS carrier switching is 2 subframes, 2 subframes and 3 subframes for 200us, 500us and 900us NR SRS carrier switching time respectively.Proposal 4. In EN-DC and NE-DC, the interruption requirements are specified for 500us LTE SRS carrier switching time only.Proposal 5. In EN-DC and NE-DC, interruption length on NR victim cells during NR SRS carrier switching are as in Table 3.Table 2. Interruption length on NR victim cell during LTE SRS carrier switching

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length X (slots) |
|
| 0 | 1 | 2 |
| 1 | 0.5 | 3 |
| 2 | 0.25 | 5 |
| 3 | 0.125 | 9 |

Proposal 6. In EN-DC, NE-DC, interruption length on LTE victim cells during LTE SRS carrier switching is 2 subframes.Proposal 7. In EN-DC, NE-DC, NR-DC and NR SA operation, requirements relevant to measurements on SSB/PBCH/CSI-RS are NOT impacted due to NR SRS carrier switching.Proposal 8. In EN-DC and NE-DC operation, requirements relevant to measurements on SSB/PBCH/CSI-RS may be impacted due to LTE SRS carrier switching.Proposal 9. In EN-DC and NE-DC operation, requirements relevant to E-UTRA measurements may be impacted due to NR SRS carrier switching. |
| [R4-2001661](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001661.zip) | Huawei, HiSilicon | Proposal 1: RAN4 shall define interruption requirements for sync and async case- Requirements are based on sync case in CA scenario- Requirements are based on async case in DC scenarioProposal 2: In CA case, the interruptions on the active serving NR cells during the switching to the PUSCH-less NR SCC shall not exceed X1 slots including the first slot where NR carrier SRS transmission is configured on the PUSCH-less SCC. The interruptions on the active serving NR cells during the switching from the PUSCH-less NR SCC shall not exceed X1 slots including the first slot where NR carrier SRS transmission is configured on the PUSCH-less SCC (X1 just consider 500us SRS carrier switching time).

|  |
| --- |
| Interruption length X1 (slots) |
| Victim cell SCS () | Aggressor Cell SCS () |
| 0 | 1 | 2 | 3 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 2 | 2 | 2 | 2 |
| 2 | 5 | 4 | 4 | 4 |
| 3 | 9 | 7 | 6 | 5 |

Proposal 3: The interruption time (one-way) for NR SRS carrier switching impacting NR CC in NR-DC is shown as below (taking 500us SRS carrier switching time as an example).

|  |  |
| --- | --- |
| Victim cell SCS () | Aggressor Cell SCS () |
| 0 | 1 | 2 | 3 |
| 0 | - | - | 2 | 2 |
| 1 | - | - | 3 | 3 |
| 2 | 5 | 4 | 4 | 4 |
| 3 | 9 | 7 | - | - |

Proposal 4: The interruption on the LTE active serving cells during NR SRS switching to the PUSCH-less NR CC shall not exceed 2 subframes including the first slot where SRS carrier transmission is configured on the PUSCH-less NR CC.The interruption on the LTE active serving cells during NR SRS switching from the PUSCH-less NR CC shall not exceed 2 subframes including the first slot where SRS carrier transmission is configured on the PUSCH-less NR CC.Proposal 5: In ENDC and NEDC, the interruption on the NR serving cells during the switching to the PUSCH-less LTE SCC shall not exceed X2 slots including the first slot where LTE carrier SRS transmission is configured on the PUSCH-less SCC.The interruption on the NR serving cells during the switching from the PUSCH-less LTE SCC shall not exceed X2 slots including the first slot where LTE carrier SRS transmission is configured on the PUSCH-less SCC.

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length X2 slot |
| 0 | 1 | 2 |
| 1 | 0.5 | 3 |
| 2 | 0.25 | 5 |
| 3 | 0.125 | 9 |

For a UE which does not support per-FR measurement gaps, interruptions to the NR serving cells caused by EUTRA SRS carrier switching are on any frequency range. For UE which support per-FR gaps, only interruptions to FR1 NR serving cells are specified. |
| [R4-2002058](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002058.zip) | Qualcomm Incorporated | Proposal 1: The interruption lengths due to NR SRS switching on NR victim cells are as given in Table 2-2Proposal 2: The interruption lengths due to NR SRS switching on NR victim cells are as given in Table 2-3Proposal 3: The interruptions on NR cells due to LTE SRS carrier switching are given in Table 2-4Proposal 4: UE to prioritize measurements over SRS switching. If the SRS switching interruptions collide with measurements, UE to drop SRS switching.  |
| [R4-2001267](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001267.zip) | ZTE | CR to TS 38.133 on SRS carrier switching interruption requirements |
| [R4-2001268](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001268.zip) | ZTE | CR to TS 36.133 on SRS carrier switching interruption requirements |
| [R4-2001662](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001662.zip) | Huawei, HiSilicon | CR to TS 36.133 on NR SRS carrier switching interruption |

## Open issues summary

### Applicability of NR SRS carrier switching time

Issue 1-1-1: How to capture applicability of SRS carrier switching time

* Proposals
	+ Option 1 (Nokia)
		- The applicability of SRS carrier switching time shall be explicitly defined in RAN4 spec:
			* 200us SRS carrier switching time applies to intra-band CA in both FR1 and FR2.
			* 200us, 500us and 900us SRS carrier switching time apply to inter-band CA in FR1 and between FR1 and FR2.
* Recommended WF:
	+ FFS

Issue 1-1-2: Whether LS RAN2 if RAN4 agrees to capture the applicability of SRS carrier switching time

* Proposals
	+ Option 1 (Nokia)
		- A LS shall be sent to RAN2 informing the applicability of the SRS carrier switching time.
* Recommended WF:
	+ No need LS to RAN2

Issue 1-1-3: Applicability of SRS carrier switching for FR2

* Proposals
	+ Option 1 (ZTE, Qualcomm, Nokia, Huawei)
		- All applicable
	+ Option 2 (MediaTek )
		- 200us only
* Recommended WF:
	+ Option 1

### SRS carrier switching interruption requirements

Background: In the last meeting it was agreed that RAN4 to define unified interruption requirements for sync and async case and the interruption requirements are based on async case (R4-1915930).

Issue 1-2-1: Whether to further define requirements for sync cases (intra-band CA, inter band CA)

* Proposals
	+ Option 1 (Huawei, Nokia)
		- Define requirements for CA (sync) and DC (async) separately
* Recommended WF:
	+ FFS. If no agreements then follow the agreements in the last meeting.

Issue 1-2-2: Interruptions due to SRS carrier switching in different frequency range

* Proposals
	+ Option 1 (ZTE, Qualcomm, MediaTek)
		- Interruptions are always allowed
	+ Option 2 (Huawei )
		- Interruptions are allowed based on UE capability
			* Allowed if UE supports per-UE measurement gap only
			* Not allowed if UE supports per-FR measurement gap
	+ Option 3 (Nokia)
		- Interruptions are not allowed for FR1+FR2 EN-DC
	+ Option 4
		- Interruptions are always not allowed
* Recommended WF:
	+ FFS

Issue 1-2-3: Interruptions on NR serving cells during NR SRS carrier switching in async operation

* Proposals
	+ Option 1 (ZTE, Qualcomm)

Table 1. Interruption length on NR victim cell during NR SRS carrier switching

|  |  |  |  |
| --- | --- | --- | --- |
|  | **NR Slot length (ms) of victim cell** | **SRS carrier switching time (us)** | **Interruption length X (slots)** |
| **Sub carrier spacing for agressor cell (kHz)** |
| 15 | 30 | 60 | 120 |
| 0 | 1 | 200 | 2 | 2 | 2 | 2 |
| 500 | 2 | 2 | 2 | 2 |
| 900 | 3 | 3 | 3 | 2 |
| 1 | 0.5 | 200 | 3 | 2 | 2 | 2 |
| 500 | 3 | 3 | 3 | 3 |
| 900 | 4 | 4 | 4 | 3 |
| 2 | 0.25 | 200 | 4 | 3 | 3 | 3 |
| 500 | 5 | 4 | 4 | 4 |
| 900 | 7 | 6 | 6 | 5 |
| 3 | 0.125 | 200 | 7 | 5 | 4 | 4 |
| 500 | 9 | 7 | 6 | 6 |
| 900 | 12 | 10 | 10 | 9 |

Note 1: If requirements for sync operation were defined, the interruptions would be 1 slot less than that in the table 1.

Note 2: The table can be further revised depending on decisions on applicability of SRS carrier switching and on interruptions due to SRS carrier switching in different frequency range.

* Recommended WF:
	+ Option 1

Issue 1-2-4: Interruptions on LTE serving cells during NR SRS carrier switching in EN-DC and NE-DC operation

* Proposals
	+ Option 1 (MediaTek, Qualcomm)

|  |  |  |
| --- | --- | --- |
| InterruptionLength(subframes) | RF transition time(us) | Aggressor cell SCS (kHz) |
| 15 | 30 | 60 | 120 |
| Victim Cell | 200 | 2 | 2 | 2 | 2 |
| 500 | 2 | 2 | 2 | 2 |
| 900 | 3 | 3 | 3 | 2 |

* + Option 2 (ZTE)
		- 2 subframes, 2 subframes and 3 subframes for 200us, 500us and 900us NR SRS carrier switching time respectively
	+ Option 3 (Huawei)
		- 2 subframes
	+ Option 4 (Nokia)



* Recommended WF:
	+ Option 1 or 2

Issue 1-2-5: Interruptions on NR serving cells during LTE SRS carrier switching in EN-DC and NE-DC operation

* Proposals
	+ Option 1 (ZTE, Qualcomm, MediaTek, Huawei, Nokia)

|  |  |
| --- | --- |
| Victim Cell SCS(KHz) | Interruption Length (slot)  |
| 15 | 2 |
| 30 | 3 |
| 60 | 5 |
| 120 | 9 |

* Recommended WF:
	+ Option 1

### Impact to RRM measurement requirements due to SRS carrier switching

Issue 1-3-1: Impact to NR RRM measurement requirements based on SSB/PBCH/CSI-RS due to NR SRS carrier switching

* Proposals
	+ Option 1 (Qualcomm)
		- UE to prioritize measurements over SRS switching. If the SRS switching interruptions collide with measurements, UE to drop SRS switching.
	+ Option 2 (MediaTek)
		- SRS Carrier switching shall avoid the collision with SSBs or RSs for any L1 measurements.
	+ Option 3 (ZTE)
		- In EN-DC, NE-DC, NR-DC and NR SA operation, requirements relevant to measurements on SSB/PBCH/CSI-RS are NOT impacted due to NR SRS carrier switching.
* Recommended WF:
	+ No impact to NR measurement requirements relevant to measurements based on SSB/CSI-RS due to NR SRS carrier switching

Issue 1-3-2: Impact on NR measurement requirements based on SSB/PBCH/CSI due to LTE SRS carrier switching

* Proposals
	+ Option 1 (ZTE)
		- In EN-DC and NE-DC operation, requirements relevant to measurements on SSB/PBCH/CSI-RS may be impacted due to LTE SRS carrier switching.
	+ Option 2 (MediaTek)
		- When SRS carrier switch from carrier 1 to carrier 2 in one CG, the UE is allowed to cause interruption to the measurement, reception and transmission in the other CG.
* Recommended WF:
	+ In EN-DC and NE-DC operation, requirements relevant to measurements on SSB/PBCH/CSI-RS may be impacted due to LTE SRS carrier switching
		- FFS how to address the issue

Issue 1-3-3: Impact to E-UTRA measurement requirements due to NR SRS carrier switching

* Proposals
	+ Option 1 (ZTE)
		- In EN-DC and NE-DC operation, requirements relevant to E-UTRA measurements may be impacted due to NR SRS carrier switching.
	+ Option 2 (MediaTek)
		- When SRS carrier switch from carrier 1 to carrier 2 in one CG, the UE is allowed to cause interruption to the measurement, reception and transmission in the other CG.
* Recommended WF:
	+ In EN-DC and NE-DC operation, requirements relevant to E-UTRA measurements may be impacted due to NR SRS carrier switching.
		- FFS how to address the issue

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Issue 1-1-3: since RF session didn’t differentiate the FR2 from FR1 case on the candidate SRS switching time, we also prefer Option 1.Issue 1-2-1: Question/comment on Option1: do we need sync DC case as well?Issue 1-2-2: if SRS is switching from CC on FR1 to CC on FR2, then interruption shall be always allowed although UE support per-FR MG. Only if UE is switching SRS within one FR and supports per-FR MG, the interruption might be not needed to the other FR. But in order to make less subcases for requirement design, we support to use option 1 (Interruptions are always allowed). Issue 1-3-2 and Issue 1-3-3: in our understanding cross RAT interruption can only be avoided if UE support per-FR MG and SRS switching is performing within one FR which is different from the FR of other RAT CCs. However, that will divide requirement into multiple conditioned subcases, and therefore we agree with ZTE’s recommended WF. |
| QC | Issue 1-1-1: All switching times as defined in the RF session are valid. We are just going to define interruption requirements for a subset of them with the understanding that if we don’t have interruption time for the time as defined in RF room, the next higher interruption time is the UE shall meet. Issue 1-1-2:We question the need to send an LS. Can Nokia say why the LS is necessary. Issue 1-1-3We should follow whatever RF room has decided. Any restrictions should come from themIssue 1-2-1: Our understanding from last meeting was the we will only define one set of requirements, namely for the asyncy. Even the sync case requirements come out to be pretty much the same once TA is accounted for. Issue 1-2-2: Issue 1-3-1I would like to clarify the WF wording. Does the WF mean that UE to continue with measurements and drop SRS switch in case of conflict.  Issue 1-3-3: In case of inter RAT (EN-DC) or different CG’s (NR-DC) the SRS interruption on other RAT or CG may cause interruptions to measurements. Agree with WF.  |
| Mediatek | Issue 1-1-1: We agree to define 200us SRS carrier switching time applies to intra-band CA in both FR1 and FR2.But for inter-band FR2, our RF understanding is that these values were for FR1.Intra-band CA: 0us, 30us, 100us, 140us and 200usInter-band CA: 0us, 30us, 100us, 200us, 300us, 500us and 900usThat’s the reason why RAN4 RF continue to discuss the SRS RF switching time in FR2 in RAN4 #88bis and #89 meetings. If the above values also apply for FR2, RAN4 RF didn’t need to discuss the values again. In the WF R4-1814156 (noted) in RAN4 #88bis meeting, the following values were proposed for FR2,* Candidate SRS switching time for FR2
	+ Intra-band CA: 0us, 30us, 100us, 140us
		- 0us means no LO retuning is needed
		- So far no inter-band CA combinations are supported for FR2.

For inter-band FR2, we think this is a new issue in R16. RAN RF didn’t have a common values for inter-band FR2. Thus, RAN4 RRM doesn’t need to define inter-band FR2 SRS requirement so urgent. Our suggestion is RAN4 RRM just focus on intra-band FR2 only.Issue 1-1-2: RAN4 RF already send the LS to clarify the SRS RF switching time. We don’t see any reason to send LS to RAN2 again.Issue 1-1-3: As we discussed in Issue 1-1-1, 500us, 900us was defined for FR1. Currently, RAN4 RF didn’t have a common understanding on the values for FR2. RRM session should follow RF session’s agreement.Technically, if we agree on the values of 500us, 900us, it’s too exaggeration. FR2 SRS switching time is even longer than legacy LTE. If we really want to define FR2 requirement, we suggest to re-use the values 200us for RF retuning time which was already agreed in NR RRM interruption requirement. Issue 1-2-1:We have already discussed this issues several meetings. And we already have an agreement on this: * RAN4 to define unified interruption requirements for sync and async case
	+ Requirements are based on async case

Since this issue was raised by Mediatek, we would like to explain more here.In CA(sync.) scenario, generally, the requirement will be shorter than async. scenario for 1 slot. But SRS transmission is an uplink behavior. In NR, the UL TA could be from 0 to at most 2 slots(larger than async. impact). The uncertainty UL TA will anyway result in additional interruption time in victim cells. CA+UL TA will have the same impact as async. case.Thus, we suggest to define the unified requirement.Issue 1-2-2:Option 2. We agree with Huawei to consider per-FR gap impact and we think we should follow other interruption requirement for per-FR gap.Issue 1-2-3:Option 1.Issue 1-2-4:Option 1. Option 2 is also fine for us.Issue 1-2-5:Option 1.Issue 1-3-1: We think option 1 and option 2 is the same meaning. Measurement priority is higher than SRS Carrier switching.Issue 1-3-2: From UE’s perspective, it had to take extra effort to effectively coordinate between an existing legacy LTE modem and a new NR modem. Thus, it’s also difficult to avoid the interruption caused by SRS carrier switching on other RAT’s measurement/reception/transmission from UE side. LTE SRS carrier switching will result in interruption on NR, including measurement/reception/transmission.Issue 1-3-3: From UE’s perspective, it had to take extra effort to effectively coordinate between an existing legacy LTE modem and a new NR modem. Thus, it’s also difficult to avoid the interruption caused by SRS carrier switching on other RAT’s measurement/reception/transmission from UE side. NR SRS carrier switching will result in interruption on LTE, including measurement/reception/transmission. |
| Intel | Issue 1-1-1: RF switching time depends on UE capability, which applies to both intra/inter-band. Therefore, 500us and 900us SRS carrier switching time should also apply to intra-band CA in both FR1 and FR2.Issue 1-1-2: support option 1. Network needs to know when to start data scheduling after SRS carrier switching.Issue 1-1-3: support option 1. Issue 1-2-1: question needs to be clarified, since we don’t have async CA. Apparently, RAN4 needs to define requirement to cover CA and DC (both sync and async). This question is rather about whether UE is allowed to cause interruption on “additional slot” on serving cell in sync case. Agreements in last meeting at least apply to DC (introduce async based requirement to cover both sync and async deployments). Regarding CA, 1 more slot interruption should be allowed for inter-band CA, since MRTD for inter-band CA is quite large compared with CP duration. Issue 1-3-1: measurement should have higher priority than SRS carrier switching. Either avoiding colliding configuration or allowing UE to drop SRS switching can solve the issue. To solve this in RAN4, we prefer option 1. |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: CGI reading requirements with autonomous gap

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2001035](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001035.zip) | MediaTek inc. | Observation 1: Whether to allow additional time for AGC and Rx beam switching (in FR2) still depends on the duration between the moment UE sending the last measurement report to the network and the moment UE receiving the CGI request from the network.Proposal 1: Define the known condition base on reported SSB other than overall SMTC duration in CGI reading.Proposal 2: For the target CGI reading in FR2 bands, the CGI reading is under the known condition if it has been meeting the following conditions:- During the period equals to [X ms] from the last transmission of the SSB used for L3-RSRP report to UE receives the target CGI reading command,- the UE has sent a valid L3-RSRP measurement report with SSB index - During the period from UE sends a valid L3-RSRP reporting to UE repots a valid CGI,- the SSBs used for L3-RSRP report remain detectable according to the cell identification conditions specified in clauses 9.2 and 9.3- the MIB information contained in the SSB used for L3-RSRP report remains decodable with the SNR ≥ [-3]dB - the RMSI CORSETs associated with the SSB used for L3-RSRP report remain detectable with the SNR ≥ [-3]dB Proposal 3: The Delay of autonomous gap based CGI reading can be divided into the following time units$$T\_{basic\\_identify\\_CGI,NR}=T\_{AGC}+ T\_{MIB, decoding}+ T\_{RMSI, decoding}$$Proposal 4: In FR1, - $T\_{AGC}=0$ for intra-frequency known CGI reading, - $T\_{AGC}=T\_{SSB}$ for inter-frequency known CGI reading. Where, $T\_{SSB}$ is the SMTC periodicity of the carrier with target cell.Proposal 5: In FR2, - $T\_{AGC}=0$ for intra-frequency known CGI reading, - $T\_{AGC}=T\_{SSB}$ for inter-frequency known CGI reading. Where, $T\_{SSB}$ is the SMTC periodicity of the carrier with target cell.Proposal 6: When the UE can be guaranteed to use the same Rx spatial filter to finish MIB decoding in FR2, the MIB decoding delay are [5]$ ×T\_{SSB}$ for both FR1 and FR2, where $T\_{SSB}$ is the SMTC periodicity of the carrier with target cell.Proposal 7: The UE’s interruption for RMSI decoding shall base on minimum RMSI scheduling periodicity 20ms. It means 8 interruption occasions shall be counted in each 160ms RMSI periodicity.Proposal 8: To guarantee the RMSI with the same SSB reporting index can be detected during the whole CGI reading, the potential SNR side condition could be [-3dB].Proposal 9: The RMSI decoding delay is [7]$ ×T\_{RMSI}$, where $T\_{RMSI}$ is the RMSI scheduling periodicity based on gNB implementation. |
| [R4-2001271](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001271.zip) | ZTE | Updated simulation assumptions for SIB1 decoding for NR CGI reading |
| [R4-2001272](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001272.zip) | ZTE | Observation 1. In FR1 for TDLC 300 channel, 90% success rate of decoding SIB1 can be achieved by 1 attempt of 8 soft combining or by 2 attempts of 4 soft combining at SNR=-6 dB.Observation 2. In FR2 for TDLC 300 channel, 90% success rate of decoding SIB1 can be achieved by 1 attempt of 4 soft combining at SNR=-4dB.Observation 3. In FR2 for TDLC 60 channel, 90% success rate of decoding SIB1 can be achieved by 1 attempt of 8 soft combining or by 2 attempts of 4 soft combining at SNR=-6dB.Observation 4. In FR2 for TDLC 60 channel, 90% success rate of decoding SIB1 can be achieved by 1 attempts of 4 soft combining at SNR=-4dB. |
| [R4-2001273](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001273.zip) | ZTE | Proposal 1. Known cell condition for FR1 is:* + It has been meeting the relevant cell identification requirement during the last 5 seconds.
		- UE sends at least a valid L3-RSRP reporting.
	+ One of the SSBs measured from the NR target cell remains detectable during CGI reading delay.

Proposal 2. Known cell condition for FR2 is:* + During the last 5 seconds before the reception of the handover command:
		- the UE has sent a valid measurement report for the target cell and
		- one of the SSBs measured from the NR target cell being configured remains detectable according to the cell identification conditions specified in clause 9.3 of TS 38.133,
	+ One of the SSBs measured from the target cell also remains detectable during the CGI reading delay according to the cell identification conditions specified in clause 9.3 of TS 38.133.

Proposal 3. SINR Side condition for CGI reading of NR cell* + For intra-frequency, Es/Iot = -[6]dB for both SSB and RMSI
	+ For inter-frequency, Es/Iot = -[6]dB for both SSB and RMSI

Proposal 4. For SIB1 decoding of NR cell in FR1 and FR2, [8] samples are needed for defining measurement time period requirements. Proposal 5: AGC/AFC time is not considered during MIB and SIB1 decoding delay. Proposal 6: Rx beam sweeping is needed during MIB decoding in FR2.Proposal 7: Rx beam sweeping is not needed for SIB1 decoding in FR2.Proposal 8: Each interruption length during MIB decoding is as in table below.

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length (slots) |
| 0 | 1 |  | 2 + TSMTC\_duration \* $N\_{slot}^{subframe,μ}$ |
| 1 | 0.5 |  | 3 + TSMTC\_duration \* $N\_{slot}^{subframe,μ}$ |
| 2 | 0.25 | Victim cell is on FR1 | 5 + TSMTC\_duration \* $N\_{slot}^{subframe,μ}$ |
| Victim cell is on FR2 | 3 + TSMTC\_duration \* $N\_{slot}^{subframe,μ}$ |
| 3 | 0.125 |  | 5 + TSMTC\_duration \* $N\_{slot}^{subframe,μ}$ |

Proposal 9: Interruption for each autonomous gap for SIB1 decoding with multiplexing pattern 1 is as in table below.

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length (slots) |
| 0 | 1 |  | 4 |
| 1 | 0.5 |  | 5 |
| 2 | 0.25 | Victim cell is on FR1 | 7 |
| Victim cell is on FR2 | 5 |
| 3 | 0.125 |  | 7 |

Proposal 10: Interruption for each autonomous gap for SIB1 decoding with multiplexing pattern 2/3 is as in table below.

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length (slots) |
| 0 | 1 |  | 3 |
| 1 | 0.5 |  | 4 |
| 2 | 0.25 | Victim cell is on FR1 | 6 |
| Victim cell is on FR2 | 4 |
| 3 | 0.125 |  | 6 |

Proposal 11: The interruption core requirements for CGI reading of NR cell is specified by ratio of interrupted slots during the MIB decoding and SIB1 decoding time period.Proposal 12: The ratio of interruption during MIB decoding is interrupted slots during one sample for MIB decoding over SMTC period in slots.Proposal 13: For multiplexing pattern 1, the ratio of interruptions is interrupted slots during one sample for SIB1 decoding over 20ms in slots. For multiplexing pattern 2/3, the ratio of interruptions is interrupted slots during one sample for SIB1 decoding over SMTC period in slots.Proposal 14: For CGI reading of NR cell and LTE cell, separated delay requirements and interruption requirements are specified in different sections.Proposal 15: Interruption requirements for CGI reading in RSTD can be reused for CGI reading of LTE cell. |
| [R4-2001364](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001364.zip) | Ericsson | Observation 1: For both FR1 and FR2, it requires the soft-combining of 4 PDSCH samples to achieve 90% if SIB1 decoding success rate with the side condition of SNR=-6dB.Observation 2: Number of SIB1 transmissions within the SIB1 transmission periodicity is up to network implementation.Observation 3: If gNB does not change the SIB1 information across the SIB1 transmission periodicities, UE may also do the soft-combining of PDSCH samples across the SIB1 transmission periodicities.Proposal 1: Derive the SIB1 reading delay based on the soft-combining of 4 PDSCH samples. RAN4 discuss further how to ensure UE can soft-combine the PDSCH symbols within the SIB1 transmission periodicity and across the SIB1 transmission periods. |
| [R4-2001403](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001403.zip) | Ericsson | Proposal 1 : Symbol level interruption is assumed for SIB decoding and there and no requirement on UE to decode SSB other than the one best in L3 RSRP reportProposal 2 : For FR2, the requirements are developed on the basis that RX beam sweeping is not assumed for MIB decodingProposal 3 : For FR2, the requirements are developed on the basis that RX beam sweeping is not assumed for SIB1 decodingProposal 4 : The known cell condition for FR2 is that an SS block with same SSB index has been meeting the relevant cell identification requirement during the last 5 seconds with the same spatial reception parameters.Proposal 5: The interruption for each autonomous gap during MIB decoding is 4 symbols (target cell SCS) + 2\*RF tuning time + 1 slot (victim cell SCS)Proposal 6 : MIB decoding delay is specified as 5 samples for both FR1 and FR2.Observation 1: Number of SIB1 transmissions within the SIB1 transmission periodicity is up to network implementation.Observation 2: If gNB does not change the SIB1 information across the SIB1 transmission periodicities, UE may also do the soft-combining of PDSCH samples across the SIB1 transmission periodicities.Observation 3 : SIB1 payload is not expected to be updated frequently compared with the SIB1 decoding delayObservation 4 : Worst case requirements for SIB1 reading across multiple transmission periods with identical payload are* 640ms + 1 slot decoding + UE processing time delay requirement
* 48 autonomous interruptions each of duration of (neighbor SIB1 slot duration + serving cell data slot duration)

 Observation 5 : Worst case requirements for SIB1 reading across a single transmission period with sufficient (4) PDSCH sample opportunities are* 320ms + 1 slot decoding + UE processing time delay requirement
* 8 autonomous interruptions each of duration of (neighbor SIB1 slot duration + serving cell data slot duration)

Proposal 7 : By default the UE assumes that PDSCH transmissions from different transmission periods can be soft combined for SIB1 decoding, if there are insufficient opportunities from a single transmission period.Proposal 8: LS is sent to RAN2 requesting assistance information to be added to the CGI decoding request (or other message e.g. measurement object configuration – the details can be for RAN2 to decide)* Assistance information is as described above
* If the serving cell does not provide information on whether it is safe to soft combine across transmission boundaries, the UE may assume that it is
* If the serving cell does not provide information on which PDSCH are transmitted, the UE decodes all valid SIB1 PDCCH using SI-RNTI to determine if it should receive PDSCH.

 The requirements for SIB1 decoding in different conditions of assistance information are specified as:

|  |  |  |
| --- | --- | --- |
| Side condition | SIB1 reading delay requirement | SIB1 interruption requirement |
| At least 4 PDSCH are decoded in slots within a single transmission period where the bitmap indicates that they can be expected, regardless of whether it is indicated as safe to soft combine across transmission periods | 320ms | 4 interruptions |
| Bitmap indicates fewer than 4 PDSCH can be expected in a single transmission period and it is indicated safe to soft combine across transmission periods | 640ms | 4\*number of ‘1’ in bitmap indicating where PDSCH can be expected |
| Fewer than 4 PDSCH are decoded in slots within a single transmission period where the bitmap indicates that they can be expected, but the bitmap indicates that at least 4 PDSCH can be expected in a single transmission period and it is indicated safe to soft combine across transmission periods | 800ms | 4\*number of ‘1’ in bitmap indicating where PDSCH can be expected |
| Fewer than 4 PDSCH can be expected in a single transmission period and it is not indicated safe to soft combine across transmission periods | No requirements e.g. UE may decide not to perform decoding | No requirements e.g. UE may attempt to decode every 20ms |

Proposal 9 : One additional sample (and autonomous interruption) is assumed for implementation aspects such as fine AFC acquisition prior to MIB decodingProposal 10 : For inter-frequency CGI reading the side condition is Es/Iot = -6dB for both SSB and RMSI |
| [R4-2001642](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001642.zip) | Huawei, HiSilicon | Proposal 1: For MIB decoding, UE is assumed to attempt decoding on all Tx beams, and with Rx beam sweeping if applicable* TMIB is 5\*N SMTC periods, where N=1 for FR1 and N=8 for FR2
* For each SMTC period during TMIB, the interruption length is SMTC duration plus RF re-tuning time and time misalignment

Proposal 2: For SIB1 decoding when SIB1 is TDM with SSB, UE is assumed to attempt decoding on a fixed Tx beam, and with fixed Rx beam* TSIB1 is Y SIB1 scheduling periods, where Y is to be derived from simulation
* RMSI/SSB multiplexing pattern 1: For each 20ms period during TSIB1, the interruption length is 2 slots plus RF re-tuning time and time misalignment
* RMSI/SSB multiplexing pattern 2/3: For each SMTC period during TSIB1, the interruption length is 4 symbols plus RF re-tuning time and time misalignment

Proposal 3: The known condition for CGI reading is defined as follows.* During the period equal to 5s before the reception of CGI reading command the UE has sent a valid measurement report for the target cell, and
* During the period of TMIB, at least one SSB of the target cell remains detectable according to the cell identification conditions, and
* During the period of TSIB1, the best SSB for MIB decoding of the target cell remains detectable with the same spatial reception parameter according to the cell identification conditions

Proposal 4: 3 SMTC samples are allowed for AGC settling for SIB1 decoding.Proposal 5: For CGI reading,* TMIB should be scaled by the same factors as for L3 RRM measurement of the target carrier, and UE is required to meet the existing RRM and L1 measurement requirements during TMIB.
* For SIB1 decoding, TSIB1 should not be scaled, but UE is not required to meet the existing RRM or L1 measurement requirements during TSIB1.
 |
| [R4-2001643](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001643.zip) | Huawei, HiSilicon | Proposal: The baseband SIB1 decoding delay is 7 SIB1 transmissions, provided that the scheduling periodicity is no larger than 80ms. |
| [R4-2001644](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001644.zip) | Huawei, HiSilicon | How to define LTE CGI reading requirements for different scenarios: |
| [R4-2002046](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002046.zip) | Nokia, Nokia Shanghai Bell | Proposal 1: Reuse known cell condition for NR FR2 handover for CGI reading with autonomous gap.Proposal 2: SIB1 decoding delay should be 4 \* SMTC periodProposal 3: Separated delay requirements and interruption requirements in different section for CGI reading of LTE cell is needed in 38.133 and 36.133Proposal 4: A generic ACK/NACK requirement is derived for the interruption requirements for CGI reading of NR cell like LTE definition.Proposal 5: Separated delay requirements and interruption requirements in different section for CGI reading of NR cell is needed in 38.133 and 36.133Proposal 6: Beam sweeping is not needed for MIB and SIB1 decoding. Proposal 7: AGC/AFC time is not considered during MIB and SIB1 decoding delay. Proposal 8: CGI reading delay of NR cell should be [9] \* SMTC period |
| [R4-2002053](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002053.zip) | Qualcomm Incorporated | Proposal 1: Interruption time for MIB decoding during CGI reading is 2\*RF tuning time + SMTC duration + 1 slot (victim SCS) Proposal 2: Interruption time for MIB decoding during CGI reading is 2\*RF tuning time + x slot (target SCS) + 1 slot (victim SCS) where x =1 for multiplexing patter 2/3 and x=2 multiplexing patter 1. Proposal 3: Re-use the known TCI state definition as known cell for CGI reading. Proposal 4: Re-using known TCI state definition as known cell, the UE will not need to do any beam sweeping for either MIB or SIB decoding in FR2.  |
| [R4-2001263](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001263.zip) | ZTE | CR to 38.133 on CGI reading of NR cell |
| [R4-2001264](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001264.zip) | ZTE | CR to 38.133 on interruption requirements for CGI reading |
| [R4-2001404](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001404.zip) | Ericsson | CR to TS 36.133 on LTE CGI measurements with autonomous gaps |
| [R4-2001405](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001405.zip) | Ericsson | CR to TS 36.133 on NR CGI measurements with autonomous gaps  |
| [R4-2001645](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001645.zip) | Huawei, HiSilicon | CR to 36.133 on interruption requirements for CGI reading |
| [R4-2001646](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001646.zip) | Huawei, HiSilicon | CR to 36.133 on CGI reading of LTE cell |

## Open issues summary

### Known cell condition for CGI reading

Background: agreements in the last meeting on known cell conditions are as follows.

|  |
| --- |
| * *Do not define requirements for unknown cells*
* *Known cell condition for FR1*
	+ *It has been meeting the relevant cell identification requirement during the last 5 seconds.*
		- *UE sends at least a valid L3-RSRP reporting.*
		- *FFS: The SSB with the same index as the one with best RSRP measurement remains detectable.*
			* *Depending on if the interruption is defined in symbol level or SMTC level.*
	+ *During CGI reading, the SSB [with the same index (in the L3-RSRP reporting)] remains detectable*
* *Known cell conditions for FR2*
	+ *Option 1: reuse known cell condition for NR FR2 handover*
	+ *Other options are not precluded*
 |

Issue 2-1-1: How the SSB is selected for MIB decoding

* Proposals
	+ Option 1 (MediaTek, Ericsson, Qualcomm, Nokia)
		- the SSB with the same index as in the L3-RSRP reporting
	+ Option 2 (ZTE, Huawei)
		- Search the best one of all the SSBs within SMTC window
* Recommended WF:
	+ Option 1

Issue 2-1-2: Known cell condition for FR1

* Proposals
	+ Option 1 (MediaTek, Ericsson)
		- It has been meeting the relevant cell identification requirement during the last 5 seconds.
			* UE sends at least a valid L3-RSRP reporting.
			* The SSB with the same index as the one with best RSRP measurement remains detectable.
		- During CGI reading, the SSB with the same index as in the L3-RSRP reporting remains detectable
	+ Option 2 (ZTE)
		- It has been meeting the relevant cell identification requirement during the last 5 seconds.
			* UE sends at least a valid L3-RSRP reporting.
		- During CGI reading, one of the SSBs measured from the NR target cell remains detectable
	+ Option 3 (Huawei)
		- During the period equal to 5s before the reception of CGI reading command the UE has sent a valid measurement report for the target cell, and
		- During the period of TMIB, at least one SSB of the target cell remains detectable according to the cell identification conditions, and
		- During the period of TSIB1, the best SSB for MIB decoding of the target cell remains detectable with the same spatial reception parameter according to the cell identification conditions
* Recommended WF:
	+ Option 1

Issue 2-1-3: Known cell condition for FR2

* Proposals
	+ Option 1 (ZTE, Nokia)
		- Reuse FR2 handover known cell conditions
	+ Option 2 (Qualcomm)
		- Re-using known TCI state definition as known cell
	+ Option 3 (Ericsson)
		- The known cell condition for FR2 is that an SS block with same SSB index has been meeting the relevant cell identification requirement during the last 5 seconds with the same spatial reception parameters.
	+ Option 4 (Huawei)
		- During the period equal to 5s before the reception of CGI reading command the UE has sent a valid measurement report for the target cell, and
		- During the period of TMIB, at least one SSB of the target cell remains detectable according to the cell identification conditions, and
		- During the period of TSIB1, the best SSB for MIB decoding of the target cell remains detectable with the same spatial reception parameter according to the cell identification conditions
	+ Option 5 (MediaTek)
		- For the target CGI reading in FR2 bands, the CGI reading is under the known condition if it has been meeting the following conditions:

- During the period equals to [X ms] from the last transmission of the SSB used for L3-RSRP report to UE receives the target CGI reading command,

- the UE has sent a valid L3-RSRP measurement report with SSB index

- During the period from UE sends a valid L3-RSRP reporting to UE repots a valid CGI,

- the SSBs used for L3-RSRP report remain detectable according to the cell identification conditions specified in clauses 9.2 and 9.3

- the MIB information contained in the SSB used for L3-RSRP report remains decodable with the SNR ≥ [-3]dB

- the RMSI CORSETs associated with the SSB used for L3-RSRP report remain detectable with the SNR ≥ [-3]dB

* Recommended WF:
	+ During the last 5 seconds before the reception of the report CGI command:
		- UE sends at least a valid L3-RSRP reporting.
		- The SSB with the same index as the one with best RSRP measurement remains detectable.
	+ During CGI reading, the SSB with the same index as in the L3-RSRP reporting remains detectable

### Delay requirements for CGI reading

Simulation results for SIB1 decoding are summarized in Table 1.

**Table 1. Number of attempts to achieve 90% of SIB1 decoding success rate with SNR=-6dB**

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency** | **Channel** | **Soft combining** | **Number of attempts** |
| **ZTE** | **Huawei** | **Ericsson** | **Nokia** | **MediaTek** |
| 4 GHz | AWGN | Single shot | - | >40 | - |  |  |
| 2  | - | 2 | 1 |  |  |
| 4 | 1 | 2 | 1 |  |  |
| 8 | 1 | 2 | 1 |  |  |
| TDL-C-300 | Single shot | - | 11 | 10 |  | 7 (at -3dB) |
| 2 | - | 6 |  |  |  |
| 4 | 2 | 4 | 1 | 1 |  |
| 8 | 1 | 4 | 1 |  |  |
| 30 GHz | AWGN | Single shot | - | >40 | - |  |  |
| 2 | - | 2 | 1 |  |  |
| 4 | 1 | 2 | 1 |  |  |
| 8 | 1 | 2 | 1 |  |  |
| TDL-C-60 | Single shot | - | 12 | 10 |  | 7 (at -3dB) |
| 2 | 13 | 6 |  |  |  |
| 4 | 2 | 4 | 1 |  |  |
| 8 | 1 | 4 | 1 |  |  |

Note1: - means success rate cannot be achieved no matter how many attempts are tried. Blank cell means no results are provided.

Issue 2-2-1: MIB decoding delay for FR1

* Proposals
	+ Option 1
		- [5] \* TSMTC, where TSMTC is SMTC periodicity of target cell.
* Recommended WF:
	+ Option 1

Issue 2-2-2: MIB decoding delay for FR2

* Proposals
	+ Option 1 (MediaTek, Ericsson, Qualcomm, Nokia)
		- [5] \* TSMTC, where TSMTC is SMTC periodicity of target cell.
	+ Option 2 (Huawei, ZTE)
		- [5] \* N \* TSMTC, where N = 8 and TSMTC is SMTC periodicity of target cell.
* Recommended WF:
	+ Option 1

Issue 2-2-3: How soft combining can be performed for different SIB1 scheduling periodicity

* Proposals
	+ Option 1 (Ericsson)
		- By default the UE assumes that PDSCH transmissions from different transmission periods can be soft combined for SIB1 decoding, if there are insufficient opportunities from a single transmission period.
		- Assistance information is needed
			* A bitmap (e.g. of up to 8 bits) where ‘0’ indicates that the UE may assume that PDSCH is not transmitted in the corresponding PDSCH transmission opportunity, and ‘1’ indicates that the UE should determine via the SI-RNTI on PDCCH whether the PDSCH is transmitted.
			* An indication that the UE may assume that it is safe to combine PDSCH across transmission period boundaries (e.g. no SIB1 payload updates are ongoing across the network)
	+ Option 2 (Huawei)
		- Requirements are based on soft combining of 2 SIB1 samples and not applicable to 160ms scheduling periodicity
* Recommended WF:
	+ FFS.

Issue 2-2-4: If LS to RAN2 to add assistance information signalling is needed

* Proposals
	+ Option 1 (Ericsson)
		- LS is sent to RAN2 requesting assistance information below to be added to the CGI decoding request (or other message e.g. measurement object configuration – the details can be for RAN2 to decide).
			* A bitmap (e.g. of up to 8 bits) where ‘0’ indicates that the UE may assume that PDSCH is not transmitted in the corresponding PDSCH transmission opportunity, and ‘1’ indicates that the UE should determine via the SI-RNTI on PDCCH whether the PDSCH is transmitted.
			* An indication that the UE may assume that it is safe to combine PDSCH across transmission period boundaries (e.g. no SIB1 payload updates are ongoing across the network)
* Recommended WF:
	+ FFS

Issue 2-2-5: How the SIB1 decoding delay is derived

* Proposals
	+ Option 1 (MediaTek)
		- One shot
	+ Option 2 (Huawei)
		- Soft combining of 2 SIB1 samples
	+ Option 3 (Ericsson, Nokia, ZTE)
		- Soft combining of 4 SIB1 samples
* Recommended WF:
	+ FFS

Issue 2-2-6: SIB1 decoding delay for FR1 and FR2

* Proposals
	+ Option 1 (MediaTek)
		- [7] \* TSIB1, where TSIB1 is the SIB1 scheduling periodicity
			* [7] is based on one shot decoding.
	+ Option 2 (Huawei)
		- [7] \* TSIB1, where TSIB1 is the SIB1 scheduling periodicity
			* [7] is based on soft combining of 2 SIB1 samples
	+ Option 3 (ZTE)
		- [8] samples
			* Based on soft combining of 4 SIB1 samples.
	+ Option 4 (Nokia)
		- 4 \* SMTC period
			* Soft combining of 4 SIB1 samples
	+ Option 5 (Ericsson)
		- The requirements for SIB1 decoding in different conditions of assistance information are specified as:

|  |  |
| --- | --- |
| Side condition | SIB1 reading delay requirement |
| At least 4 PDSCH are decoded in slots within a single transmission period where the bitmap indicates that they can be expected, regardless of whether it is indicated as safe to soft combine across transmission periods | 320ms |
| Bitmap indicates fewer than 4 PDSCH can be expected in a single transmission period and it is indicated safe to soft combine across transmission periods | 640ms |
| Fewer than 4 PDSCH are decoded in slots within a single transmission period where the bitmap indicates that they can be expected, but the bitmap indicates that at least 4 PDSCH can be expected in a single transmission period and it is indicated safe to soft combine across transmission periods | 800ms |
| Fewer than 4 PDSCH can be expected in a single transmission period and it is not indicated safe to soft combine across transmission periods | No requirements e.g. UE may decide not to perform decoding |

* Recommended WF:
	+ FFS

Issue 2-2-7: AGC/AFC for MIB decoding

* Proposals
	+ Option 1 (Nokia, ZTE)
		- No AGC/AFC is assumed during MIB decoding.
	+ Option 2 (Ericsson)
		- 1 sample for AFC
	+ Option 3 (MediaTek)
		- No AGC for intra frequency
		- 1 sample for inter frequency
* Recommended WF:
	+ FFS

Issue 2-2-8: AGC/AFC for SIB1 decoding

* Proposals
	+ Option 1 (Nokia, ZTE, Ericsson)
		- No AGC/AFC is assumed during SIB1 decoding.
	+ Option 2 (Huawei)
		- 3 sample for AGC.
* Recommended WF:
	+ FFS

Issue 2-2-9: SINR Side condition for NR CGI reading

* Proposals
	+ Option 1 (Ericsson, ZTE)
		- For inter-frequency CGI reading the side condition is Es/Iot = -6dB for both SSB and RMSI
	+ Option 2 (MediaTek)
		- To guarantee the RMSI with the same SSB reporting index can be detected during the whole CGI reading, the potential SNR side condition could be [-3dB]
* Recommended WF:
	+ -6 dB for inter frequency for both SSB and RMSI

Issue 2-2-10: Whether updated simulation assumptions in R4-2001271 is agreeable

* Proposals
	+ Option 1 (ZTE)
		- Updated simulation assumptions for SIB1 decoding for NR CGI reading
* Recommended WF:
	+ TBA

### Interruption requirements for CGI reading

Issue 2-3-1: Interruptions during MIB decoding

* Proposals
	+ Option 1 (ZTE)
		- Each interruption length during MIB decoding is as in table below.

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length (slots) |
| 0 | 1 |  | 2 + TSMTC\_duration \* $N\_{slot}^{subframe,μ}$ |
| 1 | 0.5 |  | 3 + TSMTC\_duration \* $N\_{slot}^{subframe,μ}$ |
| 2 | 0.25 | Victim cell is on FR1 | 5 + TSMTC\_duration \* $N\_{slot}^{subframe,μ}$ |
| Victim cell is on FR2 | 3 + TSMTC\_duration \* $N\_{slot}^{subframe,μ}$ |
| 3 | 0.125 |  | 5 + TSMTC\_duration \* $N\_{slot}^{subframe,μ}$ |

* + Option 2 (Ericsson)
		- The interruption for each autonomous gap during MIB decoding is 4 symbols (target cell SCS) + 2\*RF tuning time + 1 slot (victim cell SCS)
	+ Option 3 (Qualcomm)
		- Interruption time for MIB decoding during CGI reading is 2\*RF tuning time + SMTC duration + 1 slot (victim SCS)
	+ Option 4 (Huawei)
		- For each SMTC period during TMIB, the interruption length is SMTC duration plus RF re-tuning time and time misalignment
* Recommended WF:
	+ Interruption length during each MIB decoding autonomous gap

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length (slots) |
| 0 | 1 |  | TBD |
| 1 | 0.5 |  | TBD |
| 2 | 0.25 | Victim cell is on FR1 | TBD |
| Victim cell is on FR2 | TBD |
| 3 | 0.125 |  | TBD |

Note: Depending on decision on Issue 2-1-1.

Issue 2-3-2: Interruptions during SIB1 decoding

* Proposals
	+ Option 1 (ZTE)
		- Interruption for each autonomous gap for SIB1 decoding with multiplexing pattern 1 is as in table below.

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length (slots) |
| 0 | 1 |  | 4 |
| 1 | 0.5 |  | 5 |
| 2 | 0.25 | Victim cell is on FR1 | 7 |
| Victim cell is on FR2 | 5 |
| 3 | 0.125 |  | 7 |

* + - Interruption for each autonomous gap for SIB1 decoding with multiplexing pattern 2/3 is as in table below.

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length (slots) |
| 0 | 1 |  | 3 |
| 1 | 0.5 |  | 4 |
| 2 | 0.25 | Victim cell is on FR1 | 6 |
| Victim cell is on FR2 | 4 |
| 3 | 0.125 |  | 6 |

* + Option 2 (Huawei)
		- RMSI/SSB multiplexing pattern 1: For each 20ms period during TSIB1, the interruption length is 2 slots plus RF re-tuning time and time misalignment
		- RMSI/SSB multiplexing pattern 2/3: For each SMTC period during TSIB1, the interruption length is 4 symbols plus RF re-tuning time and time misalignment
	+ Option 3 (Ericsson)
		- The UE’s interruption for RMSI decoding shall base on minimum RMSI scheduling periodicity 20ms. It means 8 interruption occasions shall be counted in each 160ms RMSI periodicity.

|  |  |
| --- | --- |
| Side condition | SIB1 interruption requirement |
| At least 4 PDSCH are decoded in slots within a single transmission period where the bitmap indicates that they can be expected, regardless of whether it is indicated as safe to soft combine across transmission periods | 4 interruptions |
| Bitmap indicates fewer than 4 PDSCH can be expected in a single transmission period and it is indicated safe to soft combine across transmission periods | 4\*number of ‘1’ in bitmap indicating where PDSCH can be expected |
| Fewer than 4 PDSCH are decoded in slots within a single transmission period where the bitmap indicates that they can be expected, but the bitmap indicates that at least 4 PDSCH can be expected in a single transmission period and it is indicated safe to soft combine across transmission periods | 4\*number of ‘1’ in bitmap indicating where PDSCH can be expected |
| Fewer than 4 PDSCH can be expected in a single transmission period and it is not indicated safe to soft combine across transmission periods | No requirements e.g. UE may attempt to decode every 20ms |

* Recommended WF:
	+ FFS

Issue 2-3-3: How frequently each interruption happens during SIB1 decoding

* Proposals
	+ Option 1 (ZTE, Huawei)
		- 20ms for multiplexing pattern 1.
		- SMTC period for multiplexing pattern 2/3.
	+ Option 2 (MediaTek)
		- 20ms based on minimum MSI scheduling periodicity.
* Recommended WF:
	+ Option 1

Issue 2-3-4: How are the interruption requirements for NR CGI reading specified?

* Proposals
	+ Option 1 (ZTE)
		- The interruption core requirements for CGI reading of NR cell is specified by ratio of interrupted slots during the MIB decoding and SIB1 decoding time period.
			* The ratio of interruption during MIB decoding is interrupted slots during one sample for MIB decoding over SMTC period in slots.
			* For multiplexing pattern 1, the ratio of interruptions is interrupted slots during one sample for SIB1 decoding over 20ms in slots. For multiplexing pattern 2/3, the ratio of interruptions is interrupted slots during one sample for SIB1 decoding over SMTC period in slots.
	+ Option 2 (Ericsson)
		- it would be quite difficult to derive a formula for generic missed ACK/NACK either as an absolute value or as a ratio
	+ Option 3 (Nokia)
		- A generic ACK/NACK requirement is derived for the interruption requirements for CGI reading of NR cell like LTE definition.
* Recommended WF:
	+ FFS
		- Note: SIB1 decoding delay depending on SIB1 actual scheduling periodicity. The ACK/NACK requirements would be different for different scheduling periodicity. It is very difficult to calculate ACK/NACK for all scheduling periodicities and the requirements will be very complex.

### Requirements structure

Issue 2-4-1: How to capture interruption requirements for CGI reading of NR cell

* Proposals
	+ Option 1 (ZTE, Nokia)
		- Separated delay requirements and interruption requirements in different sections for CGI reading of NR cell
* Recommended WF:
	+ Option 1

Issue 2-4-2: How to capture interruption requirements for LTE CGI reading in EN-DC and NE-DC

* Proposals
	+ Option 1 (ZTE, Nokia)
		- Separated delay requirements and interruption requirements in different sections for CGI reading of LTE cell
	+ Option 2 (Huawei)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Measurement period  | Interruption on LTE serving cells  | Interruption on NR serving cells |
| EN-DC | 8.17 of 36.133Refer to LTE SA requirements | 8.2.1 of 38.133Same as requirements for inter-RAT RSTD |
| NR SA (including single carrier, NR CA and NR-DC) | 9.4 of 38.133 | N.A. | 8.2.2 and 8.2.4 of 38.133Refer to EN-DC requirements |
| NE-DC | Configured by PCell |  | 7.36 of 36.133Same as requirement for LTE SA | 8.2.3 of 38.133Refer to EN-DC requirements |
| Configured by PSCell | 8.19 of 36.133Refer to LTE SA requirements |

* Recommended WF:
	+ Option 1 if requirements for CGI reading of LTE cell are introduced without referring to existing requirements

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| QC | Sub topic 2-1: Issue 2-1-2Agree with options 1. We would want to ensure the same SSB index that was reported remains detectable. Issue 2-1-3We would want to keep the same SSB index in here too. So either we go with approach similar to TCI state or as proposed by MTK in option 5 with small enough value for x. Sub topic 2-2:Issue 2-2-2We are ok with the 5 SMTC as long as the TCI state corresponding to the SSB remains known at the UE. Else UE will need to do beam sweeping. Issue 2-2-3Additional signalling for just this seems like an overkill. We should balance the need for this feature with the overhead of signalling. Can we just apply the requirements for shorter SMTC periodicities, where UE has better chance of coming before SIB changes. Also the need for soft-combining could be combined with the side condition. We could do with one-shot decoding with a higher side condition.Issue 2-2-4LS needs more discussion.,Issue 2-2-5Can go with option 1 with a side condition of -3dB.Issue 2-2-7, Issue 2-2-8, Issue 2-2-9One sample for AGC for MIB. For SIB we shouldn’t really need any extra samples since MIB decoding was accomplished, UE should have good AGC/AFC at that point Side condition of -3 dB. Issue 2-2-10Ok with updating sim assumptions. Issue 2-3-3We would prefer Option 2Issue 2-3-4Specify the total number of interruptions and lengths. Generic formula will probably be hard to come by Others: |
| Medaitek | Issue 2-1-1: Option 1. CGI reading is a best effort procedure for UE. Thus, we need a strong known condition restriction and fast processing time.Issue 2-1-2: As discussed above.Issue 2-1-3: 1. For Handover, we just guarantee SSB is detectable. But for CGI reading, we should also guarantee MIB and SIB1 can be detectable by UE, otherwise how can UE decode MIB and SIB1?
2. For the known condition, we have three different time restriction, Handover-5s, SCell activation – 3s, TCI state switch -1.28s. We don’t see any difference for the definition of these known condition. All of them consider the L3 RSRP reporting as the key factor to define known condition.

Considering the CGI reading is a best effort behaviour, we suggest to have a strong restriction on known condition to guarantee no Rx beam sweeping is needed.For the side condition -3dB or -6dB, we suggest to discuss the SIB1 decoding at first then we can come back on this side condition. From our simulation, UE can’t decode the SIB1 under -6dB.Issue 2-2-1:Option 1Issue 2-2-2:Option 1 if we agree that only need to consider the SSB with the same index as in the L3-RSRP reporting.Issue 2-2-3:We should consider both one shot and soft combing in SIB1 decoding. The SIB1 periodicity is 160ms, the spec. cannot guarantee the SIB1 not changing for 4 times soft combining. For soft-combing solution, 4 times means we should also consider additional 3 shots if these 3 shots decoding didn’t have the same contents as the other 4 shots. Thus, it also need 7 shots for SIB1 decoding. We notice that E/// has a proposal to send a LS to add some signalling to help to solve this issue, but from our understanding, currently RAN2 may don’t have time to discuss this optimization signalling at this stage. Also considering the schedule restriction, RAN4 can’t wait a long time for RAN2 to discuss whether to optimize the signalling for CGI reading.If we consider that CGI reading is just a best effort procedure to UE, the UE can use one-shot solution to decode the SIB1 with higher SNR, such as -3dB. We never see any strong view to must define the side condition in -6dB. Then this issue can be solved with 7 one-shot decoding in -3dB. Issue 2-2-4:We don’t think sending a LS to RAN2 is a good solution for this issue. A better way is to define a higher SNR and use one-shot solution for SIB1 reading.Issue 2-2-5:Option 1. The same reason as issue 2-2-3, 2-2-4.Issue 2-2-6:We suggest to pending on this discussion until we have a common understanding on how to deduce the SIB1 decoding performance.Issue 2-2-7:Option 3. We can also agree with E///’s option 2 to simplify the requirement. Issue 2-2-8:Option 1.Issue 2-2-9:At first, we should discuss how to deduce the SIB1 decoding performance.Issue 2-2-10:Agree.Issue 2-3-1: If we agree on issue 1-1-1, then we can use option 2 Ericsson’s proposal.Issue 2-3-2: Before we discuss the interruption of SIB1 decoding, it’s better to agree the SIB1 decoding issues above.Issue 2-3-3:Agree on option 1.Issue 2-3-4:We don’t think these options said the same things.  |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: Mandatory MG patterns

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2000561](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000561.zip) | NTT DOCOMO INC. | Observation 1: Gap patterns with shorter MGL are valuable in FR2 since the length of SS burst set is within 3ms in most cases.Observation 2: Gap patterns with longer MGRP are valuable in FR2 considering some scheduling restrictions in FR2.Proposal 1: Gap patterns from #17 to #19 shall be mandatory support for per-FR gap for FR2 in addition to gap patterns mandated in Rel-15.

|  |  |  |
| --- | --- | --- |
| Gap Pattern Id | Measurement Gap Length (MGL, ms) | Measurement Gap Repetition Period(MGRP, ms) |
| 17 | 3.5 | 40 |
| 18 | 3.5 | 80 |
| 19 | 3.5 | 160 |

 |
| [R4-2000638](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000638.zip) | CMCC | Proposal 1: for FR1, at least the gap patterns of 3ms MGL, e.g. gap patterns #2, #3, #10, #11 need to be mandated.Proposal 2: for FR2, at least the gap patterns of 3.5ms MGL, e.g. gap patterns #16, #17, #18, #19 need to be mandated.Proposal 3: it is proposed that the additional mandatory gap patterns is applied to LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode. |
| [R4-2000993](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000993.zip) | OPPO | Proposal 1: NR only measurement is a measurement of an NR carrier when at least one NR serving cell is configured.Proposal 2: Additional mandatory gap patterns should apply for NR SA and NR-DC mode, EN-DC, NE-DC.Proposal 3: Consider GP2 and GP3 as additional mandatory gap patterns for FR1 in R16.Proposal 4: Consider GP17 and GP18 as additional mandatory gap patterns for FR2 in R16.Proposal 5:The UE shall set the bits corresponding to the measurement gap pattern 13, 14, 17 and 18 to 1 if the UE is an NR standalone capable UE that supports a band in FR2 or if the UE is an (NG)EN-DC capable UE that supports independentGapConfig and supports a band in FR2.The UE shall set the bits corresponding to the measurement gap pattern 2 and 3 to 1 if the UE is an NR standalone, EN-DC or NE-DC capable UE. |
| [R4-2001274](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001274.zip) | ZTE | Proposal 1. NR measurements only means UE cannot be configured with gap patterns with MGL<6ms for E-UTRA measurements, or for both NR and E-UTRA measurement together.Proposal 2. New UE capability is used to indicate if a gap pattern among gap patterns #2 ~ #11 can only be configured for NR measurement only.Proposal 3. No new LTE RRC signalling is to be introduced, i.e. no additional mandatory gap patterns and new UE capability for LTE.Proposal 4. New UE capability is not applicable for EN-DC.Proposal 5. Additional mandatory of gap patterns in FR2 is applicable for EN-DC.Proposal 6. Additional mandatory gap patterns and new UE capability in Rel-16 are applicable for NE-DC modeObservation 1. There are throughput loss and increased UE power consumption when longer MGL than necessary has to be used if the suitable gap pattern is not supported by UE.Observation 2. 3ms MGL and 4ms MGL are necessary in FR1 for sync and async network.Observation 3. No UE complexity issue is identified to support short MGL.Observation 4. 40/80ms MGRP should be necessarily supported. 160ms MGRP is also preferable to be supported.Proposal 7. In FR1 gap patterns with 40/80ms MGRP and 3ms/4ms MGL, i.e. GP#2, GP#3, GP#7 and GP#8 should be additionally supported.Proposal 8. In FR1 gap patterns with 160ms MGRP and 3ms/4ms/6ms MGL, i.e. GP#5, GP#9 and GP#11 are preferably to be supported.Proposal 9. In FR2 gap patterns with 40/80ms MGRP and 3.5ms MGL, i.e. GP#17 and GP#18 should be additionally supported. Gap pattern with 20ms MGRP and 3.5ms/5.5ms MGL, i.e. GP#12 and GP#16, should also be additionally supported.Proposal 10. In FR2 gap patterns with 160ms MGRP and 3.5ms/5.5ms MGL, i.e. GP#15 and GP#19 should be additionally supported. |
| [R4-2001345](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001345.zip) | Nokia, Nokia Shanghai Bell | Proposal 1: Discuss and agree on the applicability table for the new mandatory GP.Proposal 2: New mandatory GP is among GP#2 – GP#11 gap patterns.Proposal 3: New GP is among GP#6 – GP#9 gap pattern.Proposal 4: From Rel-16 GP#6 – GP#9 are defined as mandatory GPs. |
| [R4-2001400](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001400.zip) | Ericsson | Proposal 1: Supporting release 16 gaps according to the “new” release 16 capability (NR-only) means that the gap pattern is not required to be used for measurements of LTE cells.Proposal 2: 6ms legacy gap with the same MGRP and same / near same offset is allowed in LTE serving cells when making measurements according to the new release 16 (NR only) gap patternObservation 1: If the centre of LTE and NR gaps is used as a reference for timing, further extension due to asynchronous timing between LTE and NR can be avoided. |
| [R4-2001401](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001401.zip) | Ericsson | Proposal 1: At least GP17 and GP18 are considered in the discussion mandatory for release 16 UEsAssumption 1: Signaling extensions are separately discussed for rel 16 such that UEs may indicate that they only support NR measurements with GP 2, 3, 4, 6, 7, 8,10.Proposal 2: If the short measurement gap issue is addressed, at least GP2 and GP3 are considered as additional mandatory gap patterns for R16.Observation 1: UE computational complexity is not significantly increased by supporting additional(shorter) MGLObservation 2: An additional UE burden comes from implementing and especially testing of the additional mandatory gap patternsObservation 3: Network computational complexity is not significantly increased by supporting additional MG patternsObservation 4: An additional network burden comes from implementing and especially testing of the additional non-mandatory gap patterns |
| [R4-2001665](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001665.zip) | Huawei, HiSilicon | Observation: 3ms MGL for FR1 and 3.5ms MGL for FR2 has wide applicable scenarios in the realistic network.Proposal 1: Gap pattern #2, 3, 11 can be mandatory for FR1/per UE gap and gap pattern #17, 18, 19 can be mandatory for FR2 in R16.Proposal2: R15 gap pattern applicability rule for both 36.133 and 38.133 can be reused for R16.Proposal 3: The new mandatory gap patterns are not mandatory for the case with no NR measurement object.Proposal 4: The new mandatory gap patterns are mandatory for measurements with NR measurement object in EN-DC/NE-DC/SA NR. |
| [R4-2001799](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001799.zip) | MediaTek inc. | Observation 1: There should be no problem in introducing new UE capabilities for NR only measurement in Rel-16, without changing the Rel-15 capability description and gap pattern applicability rule.Proposal 1: RAN4 to confirm the definition of NR-only measurement is -- the target measurement objects to be measured within the measurement gap are all NR carriers.Proposal 1: RAN4 to confirm the scenario of NR-only measurement are all listed in the following table.Proposal 3: RAN4 to inform RAN2 the necessity of introducing a new UE capability for NR-only measurement in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode.Proposal 4: GP#15, GP#16, GP#17, GP#18, and GP#19 are added as mandatory MGs of NR-only measurement for • Rel-16 UE who supports per-UE gap or per-FR gap in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode.Proposal 5: GP#2, GP#3, GP#5-11 are added as mandatory MGs of NR-only measurement for • Rel-16 UE who supports per-UE gap in NR SA and NR-DC mode, • Rel-16 UE who supports per-FR gap in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode. |
| [R4-2002063](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002063.zip) | Qualcomm Incorporated | Proposal 1: Any gap patterns that are made mandatory in Rel-16, which were not mandatory in Rel-15, will only be mandatory for NR measurements Proposal 2: In EN-DC, NE-DC and LTE SA, for UE’s that do not support shortmeasurementgap on LTE only GP0 and GP1 should remain mandatory. Proposal 3: Any new gap patterns to be made mandatory should be mandatory with capability signaling. |
| [R4-2001269](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001269.zip) | ZTE | LS on mandatory of measurement gap patterns |
| [R4-2001402](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001402.zip) | Ericsson | LS on mandatory gap patterns for release 16 |
| [R4-2001666](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001666.zip) | Huawei, HiSilicon | LS on mandatory gap patterns in R16 |
| [R4-2001800](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001800.zip) | MediaTek inc. | LS on new capability for NR measurement and mandatory MG patterns in Rel-16 |

## Open issues summary

### UE capability and applicability of additioanl mandatory measurement gaps

Background: In the last meeting it was agreed

* Decisions on mandatory measurement gap patterns and applicability will be made in the RAN4#94 meeting.
* LS on RAN4 agreements on UE capability and mandatory measurement gap patterns will be send to RAN2 in the RAN4#94 meeting.

Issue 3-1-1: Definition of NR only measurement

* Proposals
	+ Option 1 (ZTE)
		- NR measurements only means UE cannot be configured with gap patterns with MGL<6ms for E-UTRA measurements, or for both NR and E-UTRA measurement together.
	+ Option 2 (Ericsson)
		- Supporting release 16 gaps according to the “new” release 16 capability (NR-only) means that the gap pattern is not required to be used for measurements of LTE cells.
	+ Option 3 (MediaTek)
		- The definition of NR-only measurement is the target measurement objects to be measured within the measurement gap are all NR carriers.
* Recommended WF:
	+ When an UE indicates that a gap pattern is for NR only measurement, it means the gap pattern cannot be configured for E-UTRA measurements.

Issue 3-1-2: New UE capability signalling for NR only measurements

* Proposals
	+ Option 1 (ZTE)
		- New UE capability is used to indicate if a gap pattern among gap patterns #2 ~ #11 can only be configured for NR measurement only.
		- No new LTE RRC signalling is to be introduced, i.e. no additional mandatory gap patterns and new UE capability for LTE.
		- New UE capability is not applicable for EN-DC.
	+ Option 2 (Ericsson)
		- Signaling extensions are separately discussed for rel 16 such that UEs may indicate that they only support NR measurements with GP 2, 3, 4, 6, 7, 8,10.
	+ Option 3 (MediaTek)
		- RAN4 to inform RAN2 the necessity of introducing a new UE capability for NR-only measurement in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode.
		- The scenario of NR-only measurement

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| scenario | Applicable gap | Configured MOs |
| by PCell | by PSCell |
| LTE SA | * Per-UE gap
* FR1 gap of per-FR gap
 | * LTE intra-freq
* NR inter-RAT
 | N.A |
| EN-DC | * LTE intra-freq
* NR inter-RAT
 | * NR intra-freq with or without gap
* NR inter-freq
 |
| NR SA | * NR intra-freq with or without gap
* NR inter-freq
 | N.A |
| NE-DC | * NR intra-freq with or without gap
* NR inter-freq
 | * LTE intra-freq
 |
| NR-DC | * NR intra-freq with or without gap
* NR inter-freq
 | * NR intra-freq with or without gap
* NR inter-freq
 |

* + Option 4 (OPPO)
		- The UE shall set the bits corresponding to the measurement gap pattern 13, 14, 17 and 18 to 1 if the UE is an NR standalone capable UE that supports a band in FR2 or if the UE is an (NG)EN-DC capable UE that supports independentGapConfig and supports a band in FR2.
		- The UE shall set the bits corresponding to the measurement gap pattern 2 and 3 to 1 if the UE is an NR standalone, EN-DC or NE-DC capable UE.
* Recommended WF:
	+ New UE capability is to indicate if a gap pattern among gap patterns #2 ~ #11 with MGL < 6ms can be configured for NR only measurement.

Issue 3-1-3: Applicability of additional mandatory gap patterns and new UE capability signalling

* Proposals
	+ Option 1 (ZTE)
		- Additional mandatory of gap patterns in FR2 is applicable for EN-DC.
		- Additional mandatory gap patterns and new UE capability in Rel-16 are applicable for NE-DC mode
	+ Option 2 (Ericsson)
		- For EN-DC and NE-DC, 6ms legacy gap with the same MGRP and same / near same offset is allowed in LTE serving cells when making measurements according to the new release 16 (NR only) gap pattern
	+ Option 3 (Qualcomm)
		- Any gap patterns that are made mandatory in Rel-16, which were not mandatory in Rel-15, will only be mandatory for NR measurements
		- In EN-DC, NE-DC and LTE SA, for UE’s that do not support shortmeasurementgap on LTE only GP0 and GP1 should remain mandatory.
	+ Option 4 (CMCC)
		- Additional mandatory gap patterns is applied to LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode
	+ Option 5 (Huawei)
		- R15 gap pattern applicability rule for both 36.133 and 38.133 can be reused for R16.
		- The new mandatory gap patterns are not mandatory for the case with no NR measurement object.
		- The new mandatory gap patterns are mandatory for measurements with NR measurement object in EN-DC/NE-DC/SA NR
	+ Option 6 (OPPO)
		- Additional mandatory gap patterns should apply for NR SA and NR-DC mode, EN-DC, NE-DC.
	+ Option 7 (MediaTek)
		- GP#2, GP#3, GP#5-11 are mandatory MGs of NR-only measurement for
			* Rel-16 UE who supports per-UE gap in NR SA and NR-DC mode,
			* Rel-16 UE who supports per-FR gap in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode.
		- GP#15, GP#16, GP#17, GP#18, and GP#19 for
			* Rel-16 UE who supports per-UE gap or per-FR gap in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode.
	+ Option 8 (Nokia)
		- Applicability table for the new mandatory GP.

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| **Measurement gap pattern configuration**  | **Configuration**  | **Measurement Purpose**  | **Applicability of Gap Pattern Id x** |
| Per UE Gap | EN-DC | any gap assisted measurements | No |
|  | NE-DC | any gap assisted measurements | No |
|  | NR-DC | NR FR1 and FR2 gap assisted measurements | YesNote 1  |
|  | NR SA | NR FR1 and FR2 gap assisted measurements | YesNote 1 |
|  | LTE SA | Any gap assisted measurements | No |
| Per FR Gap Note 3 | EN-DC | FR2 gap assisted measurement | YesNote 2 |
|  | EN-DC | FR2 gap assisted measurements | NoNote 4 |
|  | NE-DC | NR FR2 gap assisted measurements | yes |
|  | NE-DC | FR1 gap assisted measurements | No |
|  | NR-DC | NR FR1 and FR2 gap assisted measurements | YesNote 5  |
|  | NR SA | NR FR1 and FR2 gap assisted measurements | YesNote 5 |
|  | LTE SA | Any gap assisted measurements | No |
| Note 1: provided no LTE gap assisted measurements are configuredNote 2: provided FR2 gap pattern is configured by gNBNote 3: FR1 and FR2 gap patterns can be configured by either eNB or gNB Note 4: If gap pattern for FR1 and FR2 are configured by eNBNote 5: provided no LTE gap assisted measurements are configured in FR1 |

* Recommended WF:
	+ Additional mandatory gap patterns and new UE capability in Rel-16 are applicable to NR SA and NR-DC mode
		- Agreements in the last meeting
	+ Additional mandatory gap patterns and new UE capability in Rel-16 are applicable to EN-DC, NE-DC and LTE SA mode
		- Conditions are FFS

Issue 3-1-4: Mandatory with capability signalling

* Option 1 (Qualcomm)
	+ Any new gap patterns to be made mandatory should be mandatory with capability signaling.
* Recommended WF:
	+ FFS

### Mandatory MG patterns for Rel-16

Issue 3-2-1: Mandatory gap patterns for FR1

* Proposals
	+ Option 1 (MediaTek)
		- GP#2, GP#3, GP#5-11 are mandatory MGs of NR-only measurement for
			* Rel-16 UE who supports per-UE gap in NR SA and NR-DC mode,
			* Rel-16 UE who supports per-FR gap in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode.
	+ Option 2 (ZTE)
		- GP#2, GP#3, GP#7 and GP#8
		- GP#5, GP#9 and GP#11 are preferably to be supported.
	+ Option 3 (CMCC)
		- At least GP#2, GP #3, GP#10 and GP#11
	+ Option 4 (Ericsson)
		- At least GP#2 and GP#3
	+ Option 5 (Huawei)
		- GP#2, GP#3, GP#11
	+ Option 6 (OPPO)
		- GP#2 and GP#3
	+ Option 7 (Nokia)
		- GP#6, GP#7, GP#8 and GP#9
* Recommended WF:
	+ GP#2 and GP#3 are mandatory in FR1 for Rel-16 UE.
	+ GP#7, GP#8, GP#9 and GP#11 are further decided.

Issue 3-2-2: Mandatory gap patterns for FR2

* Proposals
	+ Option 1 (MediaTek)
		- GP#15, GP#16, GP#17, GP#18, and GP#19 for
			* Rel-16 UE who supports per-UE gap or per-FR gap in LTE SA, EN-DC, NE-DC, NR SA, and NR-DC mode.
	+ Option 2 (ZTE)
		- GP#12, GP#15, GP#16, GP#17, GP#18 and GP#19.
	+ Option 3 (CMCC)
		- At least gap patterns #16, #17, #18, #19
	+ Option 4 (Ericsson)
		- At least GP#17 and GP#18
	+ Option 5 (Huawei)
		- GP#17, GP #18 and GP#19
	+ Option 5 (NTT DOCOMO)
		- GP#17, GP#18 and GP#19
	+ Option 5 (OPPO)
		- GP#17 and GP#18
* Recommended WF:
	+ GP#16, #17, #18, #19 are mandatory in FR2 for Rel-16 UE.

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| Apple | Issue 3-1-3: support Option 3 from Qualcomm. The new mandatory MG pattern may cause different data interruption to LTE RAT compared with legacy LTE mandatory MG, so to consider the all UE implementation, we prefer to apply the new mandatory MG for NR-DC and NR-SA only with NR only MOs. Issue 3-2-1: propose to have pattern #2 and #3 as a starting point and FFS for other more pattern.Issue 3-2-2: propose to have pattern #17 and #18 as a starting point and FFS for other more pattern |
| QC | Issue 3-1-1NR only measurements in an NR SA or NR DC context would mean that the target cell is only NR. In EN-DC or LTE SA context, just the target cell being NR is not sufficient. For example, in LTE SA, the gap capability is only from LTE, so even if the target cell is NR, the UE would need to open up the configured gap on LTE too. Similarly in EN-DC. Thus, NR measurements only should mean target cell is NR and that the gap is only needed on NR serving cells. Issue 3-1-2New capability only for NR target cells and applicability only in case where no LTE serving cells need those gaps. Issue 3-2-1 and 3-2-2Can only be discussed once Section 3-1 issues are agreed upon.  |
| MediaTek | Issue 3-1-1: Definition of NR only measurement Support option 3<Comment on option 1&2> RAN4 has not studied the feasibility for UE to measure 2G or 3G measurement objects within the gap with MGL < 6ms. It exists ambiguity if we claim that the meaning of NR-only measurement gap is “this gap can't be configured for the E-UTRA measurement."Issue 3-1-2: New UE capability signalling for NR only measurements Support option 3< Comment on option 1&4> In our understanding, when shorter measurement gap is applied for the NR-only measurement in LTE SA, EN-DC and NE-DC mode, it means that UE can obtain more opportunity for intra-frequency measurement and data reception. It eventually benefits the UE. Besides, introducing a new UE capability does not mean UE is mandated to support all the gap patterns. So we prefer to also apply the capability in LTE SA, EN-DC and NE-DC mode.< Comment on option 2> Signaling extensions is also acceptable whereas companies still need to achieve consensus on the gap patterns that can be used for NR-only measurement, to ensure the extension will not introduce extra bits. Issue 3-1-3: Applicability of additional mandatory gap patterns and new UE capability signalling Support option 7< Comment on option 3> Companies might need to discuss if there exist any method to separate the capability between UE who can and can’t apply NR-only measurement gap in LTE SA, EN-DC and NE-DC mode. Issue 3-1-4: Mandatory with capability signalling < Comment on option 1> If this option is agreed, then we don’t have to agree on 2nd proposal of option 3 in Issue 3-1-3Issue 3-2-1: Mandatory gap patterns for FR1 Agree on recommended WFIssue 3-2-2: Mandatory gap patterns for FR2 Agree on recommended WF  |
| Intel | Issue 3-1-1: prefer option3. The “new” gap cannot be used for measurement of any other RAT.Issue 3-1-3: support option 3. The new mandatory GP pattern have impact on LTE data reception and intra-frequency measurement. Thus for UE which do not support shortmeasurementgap only GP0 and GP1 should remain mandatory.Issue 3-2-1: propose to mandate GP#2 and #3.Issue 3-2-2: propose to mandate GP#17 and #18 |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | **Status summary**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |